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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

OCT 14 1988

Mr. Alan Robinson
BCM Eastern, Inc.
One Plymouth Meeting
Plymouth Meeting, PA 19462

Dear Mr. Robinson,

This letter constitutes conditional approval of the Work Plan for the RI and FS for the Henderson Road NPL Site Landfill Operable Unit, received at EPA on September 14, 1988. According to the Compliance Schedule for the Landfill Operable Unit which was transmitted with my November 2, 1987 letter to you and reflected agreements reached with the PRPs at previous meetings, a draft RI and Phases 1 and 2 of the FS are due to EPA within four weeks of receipt of these comments. A copy of the November, 1987 Compliance Schedule, which is incorporated into the Consent Order, is attached; I corrected the schedule on page 95 of the Work Plan to reflect the actual commitments stipulated in the Compliance Schedule.

I propose one change be incorporated into the October, 1987 Compliance Schedule: I propose that item P, submission of performance criteria, be incorporated into item Q. The effect of this proposed change is that performance criteria would be proposed with the draft complete FS, instead of two weeks before the draft complete FS is submitted. I am sending a separate letter to the PRP Steering Committee to address this issue.

Approval of the Work Plan is conditioned upon incorporation of all EPA's comments on the Work Plan, included in this letter and enclosures 2 and 3 to this letter, into the RI/FS. My specific comments on the Work Plan are indicated in Enclosure 2. My contractor's comments, which I fully endorse, are included as Enclosure 3. My general comments are as follows:

- The November, 1987 Compliance Schedule for the Landfill Operable Unit constitutes the schedule for work to be performed under the Consent Order. A revised Compliance Schedule will be issued, reflecting the proposed change I described on the previous page, when and if the PRPs agree to this proposed change.

- The Landfill Operable Unit consists of all portions of the site affected or potentially affected by surface operations at the site. See my specific comments on paragraph 1 of page 1 of the Work Plan.

- Your proposal to install and sample two well clusters as part of the RI Phase I is not approved. While I expect that wells will be needed during a Phase 2 RI, Design, or Operation and Maintenance to characterize ground water conditions, test the validity of the ground water fate-and-transport analyses, and monitor the performance of remedial actions, we can proceed to Phases 1 and 2 of the FS without this information and thereby avoid further delays. Without a complete characterization of ground water beneath the landfill, the Endangerment Assessment will be incomplete. However, as long as this data gap is made clear in the Endangerment Assessment, alternatives may be screened as Phases 1 and 2 of the FS and a determination may be made upon conclusion of Phases 1 and 2 of the FS whether and when additional wells would be appropriate.

  Furthermore, the location for the downgradient well cluster is not adequately justified in the Landfill Operable Unit Work Plan; we have no reason to believe that a well cluster east of HR-4, which is under consideration for the injection well operable unit to intersect the northeast-trending fracture in that vicinity, will in any way represent downgradient conditions for the landfill.

  Finally, no schedule for installation of the two well clusters is proposed in the Work Plan. The well drilling activities for the Injection Well Operable Unit must proceed according to the schedule for that operable unit, when and if a Consent Decree is signed.

- The Work Plan states in several places that portions of the Injection Well Operable Unit RI/FS will be incorporated into the Landfill Operable Unit RI/FS. Please be aware that the RI for the Landfill Operable Unit must appropriately address the conditions related to surface operations. Excessive duplication of irrelevant portions of the Injection Well Operable Unit RI and/or inadequate attention to matters related to the Landfill Operable Unit will not be acceptable.

- The area east of the intermittent stream needs to be fully characterized and mapped in the RI/FS. Floodplain and regional watershed maps must be provided.

- Remedial alternatives should not be screened in the Work Plan stage. See my comments on page 62 of the Work Plan.

- The approach proposed for air modeling appears adequate, although it lacks detail. In order to avoid problems with application of the models proposed, we have scheduled a meeting with BCM and EPA on October 24.

Please contact me with any concerns. I look forward to receipt of the RI and Phases 1 and 2 of the FS on November 14. Conformance with the Compliance Schedule is critical in order to meet ROD commitments and avoid stipulated penalties.

Sincerely,

Gerallyn Valls

Gerallyn Valls
PA CERCLA Remedial Enforcement Section

enclosures (3)

cc. H. Richman
S. Speece
W. Walters
F. Costanzi BC
D. Glover BC

Enclosure 2
GDV comments
submitted 10/14/88
to BCM

WORK PLAN

FOR THE

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

SEPTEMBER 1988

BCM PROJECT NO. 00-5808-01

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BCM

CONTENTS

1.0 INTRODUCTION 1

2.0 BACKGROUND 5

2.1 Site Description 5

2.1.1 Location and Site Setting 5
2.1.2 Local and Regional Geology 5
2.1.3 Local and Regional Hydrogeology 8

3.0 REMEDIAL INVESTIGATION ACTIVITIES SUMMARY 9

3.1 General 9
3.2 Subsurface Conditions 9
3.3 Analytical Results 12

3.3.1 Initial Site Investigation 12

3.3.1.1 Surface Investigation 12
3.3.1.2 Landfill Investigation 19

3.3.2 Additional Landfill Investigation 23

3.3.2.1 General 23
3.3.2.2 Chemical Analyses - EPA Results 26
3.3.2.3 Chemical Analyses - BCM Results 32
3.3.2.4 Physical/Chemical Parameter Testing 32

3.3.3 Summary of Results 33

3.3.3.1 Fill Material 33
3.3.3.2 Natural Soils 34

3.4 Air Monitoring Summary 35

3.4.1 Initial Site Investigation 35
3.4.2 Additional Landfill Investigation 36

3.5 Underground Tank Investigation 36

4.0 FATE AND TRANSPORT EVALUATION 39

4.1 General 39
4.2 Site Description 40
4.3 Study Chemicals 40
4.4 Fate and Transport Modeling 42

CONTENTS (Continued)

4.4.1 Leachable Concentrations of the Study Chemicals 42

4.4.1.1 Chemicals Found in Water 42
4.4.1.2 Chemicals Found in Soils, Fill, or Sediment 42
4.4.2 RAM Assessment: Time Required for Leachable Concentrations of the Study Chemicals to Reach Bedrock 47

4.4.2.1 Description of the RAM 47
4.4.2.2 Difficulties Encountered in Application of the RAM 50

4.5 Results 50

4.5.1 RAM Assessment 50
4.5.2 Verification of the RAM 52
4.5.3 Fate Processes 52
4.5.4 Concentrations in Groundwater Under the Site 53
4.5.5 Fate and Transport of Metals 53

4.6 Recommendations 55

5.0 Summary of Data Quality Objectives Review 56

5.1 General 56

5.2 DQO Stage 1 - Identify Decision Types 56

5.2.1 Data Users 57
5.2.2 Evaluate Available Data 57
5.2.3 Develop Conceptual Model 57
5.2.4 Specify RI/FS Objectives 57

5.3 Conceptual Model and Evaluation of Data Sufficiency 59

5.3.1 General 59
5.3.2 Information Required for the Remedial Investigation 59
5.3.3 Information Required for the Endangerment Assessment 61
62
5.3.4 Information Required for Evaluation of Remedial Alternatives 62

CONTENTS (Continued)

6.0 REMEDIAL INVESTIGATION SCOPE OF WORK 64

6.1 Groundwater Investigation 64

6.1.1 General 64
6.1.2 Investigation Methodology 64
6.1.3 Analytical Parameters and Procedures 66

6.2 Endangerment Assessment 66

6.2.1 Hazard Identification 66

6.2.1.1 Compilation of Data 66
6.2.1.2 Identification of Chemicals of Concern 68
6.2.1.3 Asbestos 70

6.2.2 Exposure Assessment 70

6.2.2.1 Exposure Pathways 70
6.2.2.2 Concentrations at the Point of Exposure 71

6.2.3 Toxicity Assessment 72
6.2.4 Risk Characterization 72

6.2.4.1 Estimation of Chemical Intakes 72
6.2.4.2 Risk Quantitation 73

6.2.5 Environmental Risk Assessment 73

6.2.5.1 Ecology of the Site 73
6.2.5.2 Exposure and Environmental Assessment 73

6.3 Remedial Investigation Report 74

7.0 FEASIBILITY STUDY SCOPE OF WORK 77

7.1 Introduction 77
7.2 Alternative Development 77

7.2.1 Site Characterization 77

7.2.1.1 Site Description and Background 77
7.2.1.2 Site History 77
7.2.1.3 Nature and Extent of Contamination 78

7.2.2 Remedial Objectives 78
7.2.3 Identification of Applicable or Relevant and Appropriate Requirements 79

BCM

CONTENTS (Continued)

7.2.4 Identification and Screening of Remedial Technologies 84

7.2.4.1 Identification of Remedial Technologies 84
7.2.4.2 Identify Remedial Technologies 84
7.2.4.3 Screen Remedial Technologies 84

7.2.5 Development of Remedial Alternatives 87
7.2.6 Interim Reports 87

7.3 Detailed Analysis of Alternatives 88

7.3.1 Basis of Detailed Analysis 88
7.3.2 Selected Remedial Action 89

7.4 Report 90

7.5 Further Work 90

8.0 SCHEDULE 94

REFERENCES 95

APPENDICES

Appendix A Communication With O'Hara Sanitation Company, Inc.

Appendix B Monitoring Well, Test Pit and Test Boring Logs

Appendix C Underground Tank Information

Appendix D Calculation of Time Required to Remove Contaminants by Infiltrating Water

Appendix E RAM Parameters

Appendix F Groundwater Analytical Data for the PSWC "O'Hara" Monitoring Well

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TABLES

Table 3-1	Summary of Analytical Results - December 1985 and July 1986 Surface Soil and Sediment Samples	14
Table 3-2	Summary of Analytical Results - December 1985 Surface Water Samples	16
Table 3-3	Summary of Analytical Results - Surface Soil, Sediment, and Surface Water QA/QC Samples	17
Table 3-4	Summary of Analytical Results - May 1986 Test Pit Samples	21
Table 3-5	Summary of Analytical Results - Test Pit QA/QC Samples	22
Table 3-6	Sample Summary Table - Additional Landfill Investigation	25
Table 3-7	Summary of Analytical Results - EPA Analyses of November 1987 Soil Samples	27
Table 3-8	Summary of Analytical Results - BCM Volatile Organic Analyses of November 1987 Soil Samples	29
Table 3-9	Results of Physical/Chemical Parameter Testing - November 1987 Soil Samples	30
Table 3-10	Air Monitoring Summary - Initial Site Investigation	37
Table 3-11	Air Monitoring Summary - Additional Landfill Investigation	38
Table 4-1	List of Study Chemicals	41
Table 4-2	Average Concentration of Study Chemicals in Water Samples	43
Table 4-3	Concentrations of Chemicals Found Only in Solid Samples, Solubility Limits, and OLM Estimated Leachable Concentrations	45
Table 4-4	Measured and OLM-Predicted Water Concentrations	46
Table 4-5	Study Chemicals, Koc Values, and Times to Reach Bedrock	51

TABLES (Continued)

Table 4-6	Concentration of Study Metals in Fill, Water, Soil Under Fill, and Background	54
Table 5-1	Data Quality Summary Table	58
Table 6-1	Monitoring Well Analytical Parameters	67
Table 7-1	Preliminary Liisting of Possible Federal Applicable or Relevant and Appropriate Requirements	80
Table 7-2	Preliminary Listing of Possible Commonwealth of Pennsylvania Proposed Applicable or Relevant and Appropriate Requirements	82
Table 7-3	Preliminary Screening of General Response Actions and Technologies	85

FIGURES

Figure 1-1	Site Location Map	2
Figure 1-2	Sample Location Map	3
Figure 2-1	Geologic Map	7
Figure 3-1	Landfill Investigation Map	11
Figure 6-1	Proposed Monitoring Well Location Map	65
Figure 6-2	Proposed RI Report Table of Contents	75
Figure 7-1	Proposed FS Report Table of Contents	91

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Please call reports by what they are identified as in compliance schedule, cite your titles in parenthesis. Important for Admn. Record.

1.0 INTRODUCTION

A draft Remedial Investigation (RI) Report for the Henderson Road National Priorities List (NPL) Site (Site) in King of Prussia, Pennsylvania (Figure 1-1), was submitted by BCM Engineers (BCM) to the U.S. Environmental Protection Agency (EPA) Region III in October 1986 on behalf of the Henderson Road PRP Committee. EPA's review of the draft RI Report, and subsequent meetings and conversations between the EPA, Potential Responsible Party (PRPs), and BCM resulted in the following: (1) separation of the Site into two operable units (Injection Well Operable Unit [IWOU] and Landfill Operable Unit [LOU]) and (2) EPA's request for additional investigation of the Landfill Operable Unit. The Landfill Operable Unit includes an active O'Hara Sanitation Company, Inc. (O'Hara Sanitation) recycling operation, a landfill, and four underground fuel tanks which are not located within or contiguous to the landfill (Figure 1-2). The nature of the additional landfill investigation was discussed in a June 1, 1987, meeting at the EPA Region III offices in Philadelphia, Pennsylvania. The outcome of that meeting was a decision to prepare a work plan for test borings in specific areas of the landfill as requested by the EPA. Test borings in the vicinity of the underground tanks were not required by the EPA as documentation of the integrity of these underground tanks was provided and approved. Also, there was an understanding that the EPA reserved the right to request additional landfill investigation activities for the Landfill Operable Unit pending the outcome of the supplemental test boring program.

L.F. O.U. also incl former trenching area on northern periphery of L.F., past + present areas of surface ponding, and other surface drainage such as the stream on east side of site.

was sampling plan for L.F. coring only -- not a Work Plan for the L.F. RI. See Compliance Schedule

was received Jan. 20, was dated Jan 19

A Work Plan/Project Operations Plan (November 1987 Work Plan) for the additional landfill investigation was submitted to the EPA on November 16, 1987. An addendum to the Work Plan was submitted to the EPA on January 18, 1988. The field investigation outlined in the ~~Work~~ Plan was conducted from November 19 through 25, 1987. A draft Field Investigation Report, presenting the results of this field investigation, was ~~submitted~~ to the EPA on January 13, 1988. The report included a description of field activities, a map of soil boring locations, and a tabulation of analytical results. A draft Landfill ~~Investigation~~ Report was submitted to the EPA ~~on~~ March 24, 1988. This report presented a compilation of the results of the December 1985 through May 1986 initial site investigation pertaining to the Landfill Operable Unit and the results of the November 1987 additional landfill investigation, a description of field activities, and an assessment of the contaminants detected at the Landfill Operable Unit in the context of their potential fate and transport in the environment. Draft FS workplan was received at EPA on March 23, 1988.

Sampling

Fate and Transport

At the request of the EPA (letter dated April 22, 1988, from Geralyn Downes-Valls of EPA to Alan Robinson of BCM), BCM has prepared this Work Plan for the Henderson Road Site Landfill Operable Unit RI Report.

Revised Compliance Schedule was sent w. Nov. 2, 1987 letter re: Landfill Operable Unit from Valls to Robinson.
RI workplan was scheduled to be submitted 2/17/88. [EPA did not comment on March FS workplan because EPA was awaiting RI workplan with the FS.] First draft RI workplan was rec'd 7/20/88. This also included a draft FS workplan. EPA commented on 7/20/88 RI/FS workplan on 8/5/88. This RI/FS WP was prepared in response to EPA's 8/5/88 comments.

SOURCE: USGS 7.5 min. Quadrangle / Norristown, PA / Photorevised 1983

north 0 2000ft.

00-5528-01 and 00-5528-02

HENDERSON ROAD
FEASIBILITY STUDY
King of Prussia, PA

ure 1-1
Location Map

This Work Plan was prepared within the context of an assessment of what additional work was necessary to complete the RI and provide the basis for the screenings and evaluations of remedial technologies and alternatives in the Feasibility Study (FS). The quantity and quality of the data obtained to date were reviewed within the context of the Data Quality Objectives for Remedial Response Activities (EPA, 1987) and the requirements of the Endangerment Assessment (EA) and FS.

Ref 2

The Landfill Operable Unit was originally designated to consist of the area of the trash and debris fill on the eastern portion of the Site and the four underground tanks adjacent to the O'Hara Sanitation buildings. Documentation provided in Appendix D of the March 1988 draft Landfill Investigation Report confirmed that the tanks were tested tight. Consequently, no further investigation of the underground tanks was required by the EPA. Section 3.5 contains a description of the underground tank investigation.

+ pond + trench area + stream

A summary of background information, including a site description and results of the initial site investigation and the additional landfill investigation, is contained in Section 2.0. A summary of previous remedial investigation activities is contained in Section 3.0; a summary of the fate and transport evaluation is contained in Section 4.0. A summary of the data quality objectives review is contained in Section 5.0. A description of the RI tasks to be performed, including the development of an endangerment assessment and preparation of a RI Report for the Landfill Operable Unit, is included in Section 6.0. A description of the proposed scope of work for the FS is included as Section 7.0. An outline of project planning, including a summary of project plans and schedule, is contained in Section 8.0.

RI will be conducted in accordance with the EPA Interim Final Guidance for Conducting RI and FSs under CERCLA (August, 1988) (OSWER Directive 9355.3-01). Describe phased RI/FS approach.

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10 data gaps, including but not limited to: flood plain mapping
• req'd watershed mapping
- site utilities map
- site map of paved areas
- site parcel map to include properties east of site
- map of test pit, core + sediment ... like Fig. 4-11 in IW RI

2.0 BACKGROUND

A full description of background information on the site and environs has been provided in the Remedial Investigation Report - Injection Well Operable Unit (BCM, 1988). A full description has not been provided herein, but will be included in the RI report for the Landfill Operable Unit.

2.1 SITE DESCRIPTION

2.1.1 Location and Site Setting

The Henderson Road Site is located in Upper Merion Township, Montgomery County, Pennsylvania (Figure 1-1). The Site is bounded on the north by the Pennsylvania Turnpike (Turnpike), on the south by Conrail (formerly the Pennsylvania Railroad) tracks, to the east by the Southeastern Pennsylvania Transportation Authority (SEPTA) (formerly the Philadelphia and Western) Norristown High-Speed Line right-of-way, and to the west by South Henderson Road. O'Hara Sanitation occupies the Site with several automobile repair shops and a drilling contractor. The Site is used by O'Hara Sanitation for waste storage, waste recycling, vehicle maintenance and parking, and office facilities. The O'Hara Sanitation office and parking lot front on South Henderson Road. Behind the O'Hara Sanitation office (to the east) is a garage complex. The automobile repair shops and the drilling contractor occupy buildings within the garage complex.

A former industrial water supply well, used on or about March 22, 1977, and reportedly at other times between 1975 to March 1977 for the disposal of industrial waste liquids, is located within the O'Hara Sanitation maintenance garage. This well, which has been termed the "Injection Well," lies beneath the floor of the maintenance garage and is capped by a concrete slab. An inactive landfill is situated to the east of the garage complex. The landfill is characterized by a large paved parking area and a staging area for the sorting of construction/demolition debris, junked cars and trucks, and other miscellaneous waste items prior to offsite disposal. O'Hara Sanitation has reported (Appendix A) that it is actively planning to move the recycling operation offsite and extend the paved or stoned parking area. This program is planned for completion by December 1988. Four underground fuel storage tanks, three containing diesel fuel and one containing gasoline, are currently situated on the property.

NO See Sept 27, 1988 DER order.

2.1.2 Local and Regional Geology

The entire Henderson Road Site is underlain by the Conestoga Formation. The overburden, the upper portion of which consists mainly of fill and

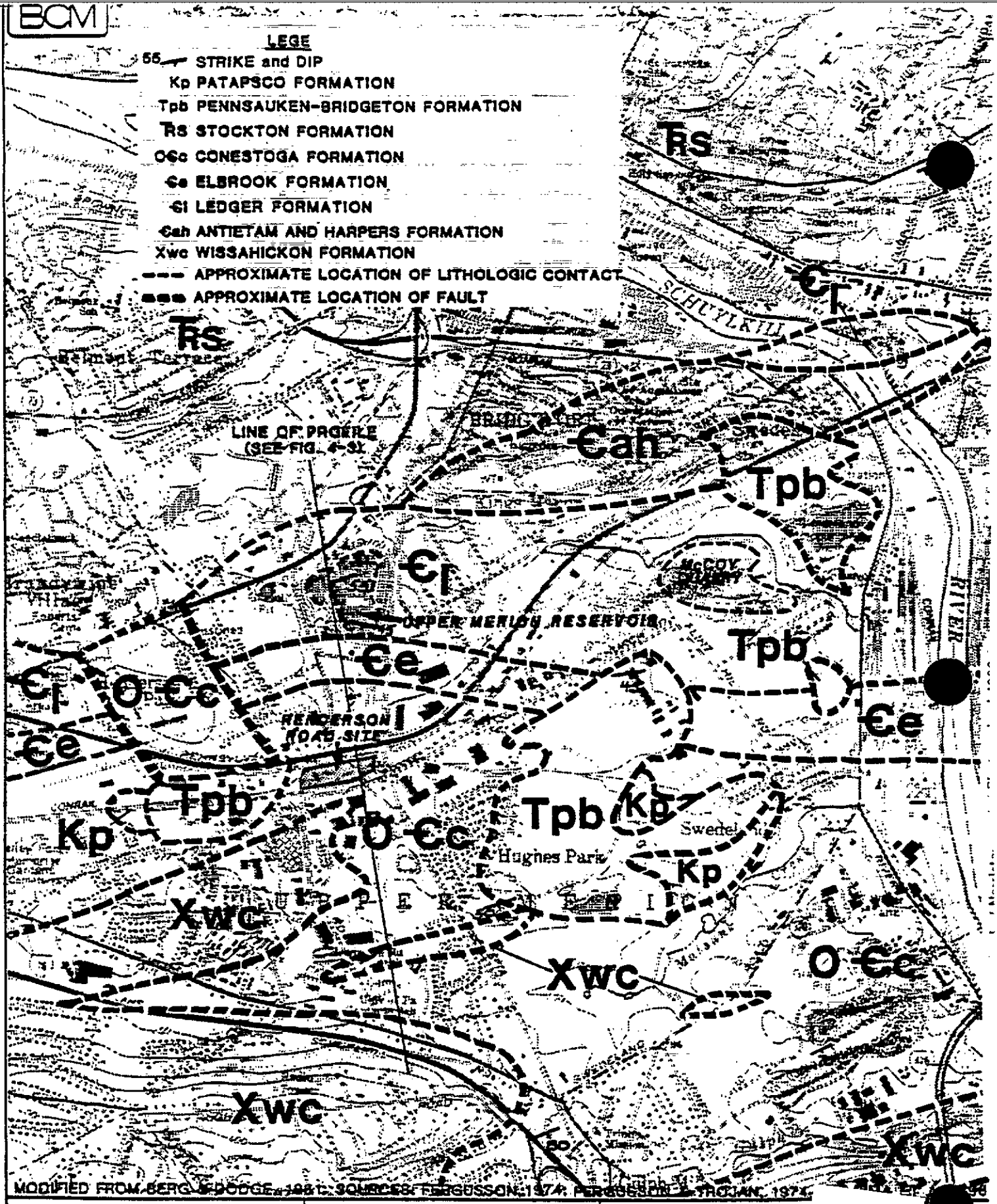
residual soils, grades into a weathered bedrock zone above competent limestone. Overburden thicknesses increase from the southern part of the site (HR-1 series wells, 35 to 55 feet) northward to the Turnpike (80 to 100 feet). At HR-RE-205, the well closest to the Injection Well, depth to bedrock was 45 feet. North of the Turnpike, 180 feet of soil and brecciated material was encountered above bedrock during the drilling of well HR-5-192. Some of the material was identified as Ledger dolomite, indicating the possibility of a fault zone. Preferential solutioning, including possible major sinkhole activity and a structural collapse along this zone of structural weakness, may have caused the thick overburden in the vicinity of the HR-4 cluster and HR-5 well.

The Upper Merion Reservoir (UMR) is located north of the Site. The UMR is operated by the Philadelphia Suburban Water Company (PSWC) as a public drinking water source and is situated 2,000 feet north of the Site. The UMR, which is the former Bridgeport Quarry, receives all groundwater recharge water from a 2.4-square-mile groundwater drainage basin (estimated) and from induced groundwater recharge originating from the bed of the Schuylkill River, 1.7 miles east of the Site.

The UMR and the Henderson Road Site are situated at the northeastern edge of the Chester Valley in the Piedmont Physiographic Province. The Chester Valley is a narrow, elongate, northeast-trending physiographic feature that consists of Cambro-Ordovician limestones and dolomites (Newport, 1971). A geologic map of the area is shown as Figure 2-1 (Berg and Dodge, 1981). Crystalline rocks, principally the Wissahickon Schist of early Paleozoic or Precambrian age, border the Chester Valley to the south. In the vicinity of the Site, the Wissahickon Schist (XWC), as illustrated in Figure 2-1, includes a zone less than 500 feet south of the western portion of the Site and south of the Schuylkill Expressway (I-76), 4,000 feet south of the Site. Within the Chester Valley, carbonate rock sequences unconformably contact the crystalline rocks and dip approximately 45 degrees to the south-southwest (Leggette, Brashears and Graham, 1981). From oldest to youngest, the carbonate sequence of the Chester Valley includes the Ledger, Elbrook, and Conestoga Formations. The northern boundary of the Chester Valley is marked by occurrences of the underlying Harpers-Antietam Formation (quartzite-phyllite lithology) or terminates where the sandstone and siltstone of the Triassic-age Stockton Formation unconformably overlie the Paleozoic rocks.

Site geology, including geologic logs of onsite groundwater monitoring wells, has been documented in the Injection Well Operable Unit Remedial Investigation Report.

RI must address ground water classification of aquifer beneath site.



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00-5528-01 and 00-5528-02

HENDERSON ROAD
REMEDIAL INVESTIGATION
King of Prussia, PA

Figure
Geologic Map

AR303357

2.1.3 Local and Regional Hydrogeology

Groundwater levels beneath the Site have been lowered to between 120 and 160 feet below ground surface as a result of, at first, the quarry dewatering and, now, the current UMR pumping stress. As a result of the UMR pumping, groundwater from the Site and environs flows northerly towards the UMR. The UMR behaves like a very large well in that it draws down water from the surrounding area and beyond to yield a 7.5 million gallons per day water supply. Groundwater flow from the Site to the UMR is in a northerly direction and has been since well before 1977, when the UMR was a 400-foot-deep dolomite quarry. Groundwater beneath the Site flows through fractures, bedding planes, and related solution features in the limestone bedrock. These features are oriented in northeasterly and northwesterly directions beneath the Site and between the Site and the UMR.

A fault northwest of the site may also preferentially convey area groundwater. Groundwater does not flow in a direct line north from the Site to the UMR, it flows through northeasterly and northwesterly-trending fractures. Therefore, the groundwater travel distance from the Site to the UMR is estimated to be 3,000 feet, a factor 1.5 times the straight line distance of 2,000 feet. The rate of groundwater flow was calculated in the Injection Well RI to be on the order of 6.5 feet per day with a calculated possible range of 2.4 feet per to 13.3 feet per day. Using the rate of 6.5 feet per day, and the estimated 3,000-foot distance for travel via fractures, the period of time required for groundwater to flow from the Site to the UMR is calculated as 1.2 years, with the range of calculated times being 0.6 years to 3.4 years.

Additional information on Site geology and hydrogeology may be found in the Injection Well Unit RI Report.

3.0 REMEDIAL INVESTIGATION ACTIVITIES SUMMARY

3.1 GENERAL

An initial site investigation was conducted between December 1985 and August 1986 as part of the remedial investigation for the Henderson Road Site. Specific investigations pertaining to the landfill unit included a surface investigation (analyses of surface soil, sediment, and water samples conducted between December 1985 and July 1986) and a landfill investigation (excavation of 15 test pits and analyses of 7 soil and leachate samples) conducted in May 1986. An additional landfill investigation was conducted in November 1987. Six test borings were drilled onsite and soil samples were obtained for analyses. In addition, an investigation of the four onsite underground tanks was conducted to assess their potential impact (if any) at the site.

Results of these investigations, including subsurface lithology, analytical results, an air monitoring summary, and the underground tank investigation, are contained in Sections 3.2, 3.3, and 3.4, and 3.5, respectively. Sampling and analyses were in accordance with the November 1985 Project Operations Plan (POP) for the Henderson Road Site and the November 1987 ~~Work~~ Plan for the Landfill Operable Unit prepared by BCM and approved by EPA prior to initiating field work. Monitoring well and test pit logs from the initial site investigation and test boring logs from the additional landfill investigation, as well as boring logs from a previous investigation by International Environmental Engineers (IEE), are included in Appendix B.

3.2 SUBSURFACE CONDITIONS

The areas of known landfill activity are indicated in Figure 3-1. In addition, the thickness and type of fill material observed during subsurface investigations (monitoring wells, test borings and test pits) are indicated in Figure 3-1. The materials in the landfill consist of two general categories of fill: (1) cinder fill, which is composed of black cinders with broken cinder blocks, and (2) trash fill, which is composed of a mixture of construction and demolition debris and commercial and domestic trash. The fill material occupies approximately 40,000 square yards (~~sq yd~~) ~~or~~ 8.3 acres. The trash fill occupies approximately 28,000 square yards or 5.8 acres. Minor amounts of soil fill were occasionally observed in test pits and in soil borings, occurring as thin layers interlayered with trash and cinder fill. The cinder fill apparently resulted from the operations of the Ellis Concrete Company, which occupied the Site prior to the initiation of the O'Hara Sanitation operations in December 1974. The trash fill is associated with the operations of O'Hara waste company.

Total fill thickness generally increases slightly from west to southeast across the Site and is largely controlled by variations of the underlying topographic expression of the natural soils. Thickness of the landfill materials at test pits 2, 6, 7, 8, 9, 12, and 15 could not be determined using backhoe excavation techniques because the depths to the underlying soils exceeded the maximum range of the backhoe. In the test borings drilled in November 1987, fill material was encountered in Borings B-1, B-2, B-2A, and B-3 to depths of 14.8 feet, 14.3 feet, 13.5 feet, and 17.4 feet, respectively. No fill material was detected in Boring B-4, the background boring. The greatest fill thicknesses, ranging from 11 feet to 17.4 feet, were observed in the central, and south central areas of the landfill (test pits 6, 7, 8, 9, 14, and 15, and Boring B-3) at the approximate location of a reported former trench (CDM/Weston, 1985) and in the northeastern corner of the landfill (Boring B-1).

Cinder fill materials are exposed on the surface along the western, northwestern, and southwestern areas of the Site (Figure 3-1). This material was encountered during the drilling of monitoring wells at Locations 2 and 3 and at the replacement well (HR-RE-205) and it underlies much of the garage complex area. Test pits 2, 14, and 15 penetrated the trash fill and confirmed the presence of the underlying cinder fill. Cinder material was also encountered at Boring B-3 to a depth of 6.3 feet. The precise eastern extent of the cinder fill is uncertain because several of the excavations (test pits 6, 7, 8, 9, and 12) were unable to penetrate fully through the trash fill to confirm the presence or absence of the cinder fill. However, cinder fill was encountered mixed with trash fill above natural soils in the eastern areas (Borings B-1, B-2, and B-2A).

HR2+3? based on what?

The trash fill increases in thickness to the east attaining a maximum observed thickness of 14.8 feet in Boring B-1. The materials encountered varied among the test pits and borings. In general, the trash fill consists of wood, metal, tires, plastic, paper, and cloth. Assuming a trash fill thickness of 15 feet, the maximum volume of trash fill is estimated to be on the order of 140,000 cubic yards.

Liquid was encountered in several of the test pits and borings in the central and south central portions of the landfill (test pits 2, 5, 6, 7, 8, 12, and 14 and Borings B-2 and B-3) at depths of 3 to 10 feet below ground surface. The surface of the water varied in elevation (above mean sea level) from approximately 153 feet in test pit 5 to 144 feet in test pits 7 and 14. The water is impounded within the landfill and is perched within the fill material and on the surface of the underlying natural soil. No water or leachate seeps were observed along the eastern edge of the landfill. The liquid within the landfill material represents a perched water zone approximately 120 feet above the regional water table.

appears

when was this observation made? Was it a dry or wet spell? How many times was area checked? Address in RI; is there a potential data gap?

Perched water zones occur when water, after having infiltrated through the landfill surface, reaches a zone of lower permeability. Beneath the landfill, the natural fine-grained soil has a lower permeability than the trash fill and impedes vertical flow. The volume of this water in the landfill probably varies seasonally and in response to precipitation events: greater volume (and higher elevation) in the winter, spring, and after major precipitation events; lesser volume (and possibly elimination) during summer, fall, and extended periods of below average precipitation.

A natural clayey silt to silty clay soil was encountered in the background boring (B-4) and beneath the fill material in boring locations B-1, B-2, and B-3 to depths of 21 feet, 34 feet, 46 feet, and 50.5 feet, respectively. Bedrock, which has been identified as limestone of the Conestoga Formation, was encountered in Borings B-1 and B-2 at depths of 34 feet and 46 feet, respectively.

3.3 ANALYTICAL RESULTS

3.3.1 Initial Site Investigation

Summarize EPA surface investigations prior to 1986, in RI

3.3.1.1 Surface Investigation

Ten surface soil samples (BS1 through BS10) were obtained on December 12, 1985 (Figure 3-1). These samples were obtained prior to remedial investigation activities to establish baseline site conditions for health and safety protocol. Two surface water samples (WA-4 and WA-5) and two sediment samples (SED-4 and SED-5) were obtained December 19, 1985, from an onsite area of ponded water. Three sediment samples (SED-1, SED-2, and SED-3) were obtained in July 1986 from an intermittent stream which runs along the eastern edge of the Site. Since the stream was dry during these two sampling events, surface water samples from the stream could not be collected. The surface water and sediment samples were obtained to help establish air quality characterization prior to initiation of field activities and to establish upgradient and downgradient surface conditions regarding the potential for migration of contaminants via surface water.

The 10 surface soil samples were analyzed for volatile organic compounds. The samples were then composited (BS Comp) and analyzed for semi-volatile organic compounds, inorganic compounds (metals and cyanide) and total phenols. The two water samples were analyzed for volatile organic compounds. The samples were then composited (WA-4-5) and analyzed for metals and specific conductance. Sediment samples SED-4 and SED-5 were analyzed for volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls (PCBs), pesticides, and metals.

Sediment samples SED-1, SED-2, and SED-3 were analyzed for volatile organic compounds, semi-volatile organic compounds, metals, PCBs, and pesticides. Analytical results for the surface soil and sediment samples and for the surface water samples are summarized in Tables 3-1 and 3-2, respectively. Analytical results of the QA/QC blanks accompanying these samples are summarized in Table 3-3.

Surface Soil Samples

The analyses of the 10 surface soil samples (BS1 through BS10) indicated the presence of seven volatile organic compounds. Maximum concentrations of the volatile compounds detected include chlorobenzene (670 micrograms per kilogram [ug/kg]), methylene chloride (100 ug/kg), tetrachloroethene (3,760 ug/kg), toluene (200 ug/kg), 1,1,1-trichloroethene (40 ug/kg), trichloroethene (50 ug/kg), and trichlorofluoromethane (540 ug/kg). Trichloroethene, which was detected in sample BS2 at 50 mg/kg, was also detected in the trip blank accompanying the sample at 2.2 micrograms per liter (ug/l). Analyses of the composite soil sample (BS Comp) indicated the presence of semi-volatile compounds, inorganic compounds, and total phenolics. Since BS Comp is a composite of 10 samples, distribution of the detected contaminants can not be determined.

Twelve semi-volatile compounds, all base/neutral extractable compounds, were detected in the surface soil samples, including acenaphthene (1,800 ug/kg), anthracene (2,300 ug/kg), benzo(a)anthracene (6,500 ug/kg), benzo(a)pyrene (5,500 ug/kg) benzo(b)fluoranthene (10,000 ug/kg), benzo(k)fluoranthene (10,000 ug/kg), bis (2-ethylhexyl) phthalate (3,300 ug/kg), chrysene (6,000 ug/kg), fluoranthene (13,000 ug/kg), fluorene (1,600 ug/kg), phenanthrene (14,000 ug/kg), and pyrene (9,400 ug/kg).

Eight metals and cyanide were detected, including arsenic (0.03 mg/kg), cadmium (0.9 mg/kg), chromium (3.0 milligrams per kilogram [mg/kg]), copper (2.39 mg/kg), cyanide (0.187 mg/kg), lead (9.94 mg/kg), mercury (0.45 mg/kg), nickel (7.74 mg/kg), and zinc (129.0 mg/kg).

Total phenolics were detected at 0.231 mg/kg.

Onsite Ponded Water and Sediment Samples

The analyses of onsite ponded water (samples WA-4 and WA-5) indicated the presence of eight volatile organic compounds, at similar levels, in each sample. Maximum concentration of the primary volatile compounds detected include toluene (844 ug/l), trichlorofluoromethane (368 ug/l), and 1,1,1-trichloroethane (6.8 ug/l). Total volatile compounds detected were 1,225.5 ug/l and 1095.6 ug/l for WA-4 and WA-5, respectively. Sediment

TABLE 3-1

SUMMARY OF ANALYTICAL RESULTS
DECEMBER 1985 & JULY 1986 SURFACE SOIL & SEDIMENT SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID:	N521909	N521910	N521911	N521912	N521913	N521914	N521915	N521916
SAMPLE DATE:	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85
SAMPLE NAME:	BS1	BS2	BS3	BS4	BS5	BS6	BS7	BS8
Parameter (Units)								
Volatile Compounds (ug/kg)								
Acetone	NT	NT	NT	NT	NT	NT	NT	NT
Benzene	<10	<10	<10	<10	<10	<10	<10	<10
Carbon Tetrachloride	<10	<10	<10	<10	<10	<10	<10	<10
Chlorobenzene	110	60	670	250	<10	170	<10	370
1,2-Dichloroethane	<10	<10	<10	<10	<10	<10	<10	<10
Cis-1,3-Dichloropropene	<10	<10	<10	<10	<10	<10	<10	<10
Ethylbenzene	<10	<10	<10	<10	<10	<10	<10	<10
Methylene Chloride	100	80	70	50	<10	30	50	<10
Tetrachloroethene (PCE)	300	3,760	70	<10	<10	<10	<10	<10
Toluene	200	110	100	20	<10	40	170	120
1,1,1-Trichloroethane	<10	40	<10	<10	<10	<10	10	<10
Trichloroethene (TCE)	<10	50	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	60	120	360	40	<10	500	540	<10
TOTAL VOLATILES DETECTED	770	4,220	1,270	360	ND	740	770	490
Semivolatile Compounds (ug/kg)								
Acenaphthene	NT	NT	NT	NT	NT	NT	NT	NT
Anthracene	NT	NT	NT	NT	NT	NT	NT	NT
Benzidine	NT	NT	NT	NT	NT	NT	NT	NT
Benzo(a)Anthracene	NT	NT	NT	NT	NT	NT	NT	NT
Benzo(a)Pyrene	NT	NT	NT	NT	NT	NT	NT	NT
Benzo(b)Fluoranthene	NT	NT	NT	NT	NT	NT	NT	NT
Benzo(k)Fluoranthene	NT	NT	NT	NT	NT	NT	NT	NT
Benzo(g,h,i)Perlyene	NT	NT	NT	NT	NT	NT	NT	NT
Bis(2-Chloroethyl)Ether	NT	NT	NT	NT	NT	NT	NT	NT
Bis(2-Ethylhexyl)Phthalate	NT	NT	NT	NT	NT	NT	NT	NT
Butyl Benzyl Phthalate	NT	NT	NT	NT	NT	NT	NT	NT
Chrysene	NT	NT	NT	NT	NT	NT	NT	NT
Dibenzo(a,h)Anthracene	NT	NT	NT	NT	NT	NT	NT	NT
Dibenzofuran	NT	NT	NT	NT	NT	NT	NT	NT
Fluoranthene	NT	NT	NT	NT	NT	NT	NT	NT
Fluorene	NT	NT	NT	NT	NT	NT	NT	NT
Indeno(1,2,3-cd)Pyrene	NT	NT	NT	NT	NT	NT	NT	NT
2-Methylnaphthalene	NT	NT	NT	NT	NT	NT	NT	NT
Naphthalene	NT	NT	NT	NT	NT	NT	NT	NT
Phenanthrene	NT	NT	NT	NT	NT	NT	NT	NT
Pyrene	NT	NT	NT	NT	NT	NT	NT	NT
Pesticides and PCBs (ug/kg)								
Aldrin	NT	NT	NT	NT	NT	NT	NT	NT
alpha-BHC	NT	NT	NT	NT	NT	NT	NT	NT
delta-BHC	NT	NT	NT	NT	NT	NT	NT	NT
4,4'-DDT	NT	NT	NT	NT	NT	NT	NT	NT
Dieldrin	NT	NT	NT	NT	NT	NT	NT	NT
Heptachlor	NT	NT	NT	NT	NT	NT	NT	NT
Inorganic Compounds (mg/kg)								
Antimony	NT	NT	NT	NT	NT	NT	NT	NT
Arsenic	NT	NT	NT	NT	NT	NT	NT	NT
Beryllium	NT	NT	NT	NT	NT	NT	NT	NT
Cadmium	NT	NT	NT	NT	NT	NT	NT	NT
Chromium	NT	NT	NT	NT	NT	NT	NT	NT
Copper	NT	NT	NT	NT	NT	NT	NT	NT
Cyanide	NT	NT	NT	NT	NT	NT	NT	NT
Lead	NT	NT	NT	NT	NT	NT	NT	NT
Mercury	NT	NT	NT	NT	NT	NT	NT	NT
Nickel	NT	NT	NT	NT	NT	NT	NT	NT
Thallium	NT	NT	NT	NT	NT	NT	NT	NT
Zinc	NT	NT	NT	NT	NT	NT	NT	NT
Total Phenolics (mg/kg)	NT	NT	NT	NT	NT	NT	NT	NT

NT Not tested as part of this study

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

Table 3-1 (Cont'd)

LABORATORY ID:	N521917	N521918	N521921	613326	613327	613328	522399	522400
SAMPLE DATE:	12/12/85	12/12/85	12/12/85	07/18/86	07/18/86	07/18/86	12/19/85	12/19/85
SAMPLE NAME:	BS9	BS10	BS COMP	SED-1	SED-2	SED-3	SED-4	SED-5
Parameter (Units)								
Volatile Compounds (ug/kg)								
Acetone	NT	NT	NT	<12.0	<12.0	9.1	NT	NT
Benzene	<10	<10	NT	<6.0	<5.9	<5.5	100	150
Carbon Tetrachloride	<10	<10	NT	<6.0	<5.9	<5.5	<10	20
Chlorobenzene	<10	<10	NT	<6.0	<5.9	<5.5	<10	<10
1,2-Dichloroethane	<10	<10	NT	<6.0	<5.9	<5.5	<10	9,110
Cis-1,3-Dichloropropene	<10	<10	NT	<6.0	<5.9	<5.5	<10	50
Ethylbenzene	<10	<10	NT	<6.0	<5.9	<5.5	480	430
Methylene Chloride	50	20	NT	37.0	50.0	39.0	<10	<10
Tetrachloroethene (PCE)	140	<10	NT	<6.0	<5.9	<5.5	<10	<10
Toluene	120	30	NT	<6.0	<5.9	<5.5	2,570	4,650
1,1,1-Trichloroethane	<10	<10	NT	<6.0	<5.9	<5.5	<10	<10
Trichloroethene (TCE)	<10	<10	NT	<6.0	<5.9	<5.5	<10	<10
Trichlorofluoromethane	150	40	NT	NT	NT	NT	<10	<10
TOTAL VOLATILES DETECTED	460	90	NT	37.0	50.0	48.1	3,150	14,410
Semivolatile Compounds (ug/kg)								
Acenaphthene	NT	NT	1,800	220	250	250	<1,000	<1,000
Anthracene	NT	NT	2,300	590	610	550	<1,000	<1,000
Benzidine	NT	NT	<1,600	NT	NT	NT	7,300	<1,000
Benzo(a)Anthracene	NT	NT	6,500	1,300	1,500	1,200	<1,000	<1,000
Benzo(a)Pyrene	NT	NT	5,500	1,300	1,400	1,200	<1,000	<1,000
Benzo(b)Fluoranthene	NT	NT	10,000	2,300	2,900	2,300	6,800	<1,000
Benzo(k)Fluoranthene	NT	NT	10,000	2,300	2,900	2,300	<1,000	<1,000
Benzo(g,h,i)Perlyene	NT	NT	<4,000	690	570	740	<1,000	3,000
Bis(2-Chloroethyl)Ether	NT	NT	<1,600	<820	<410	<750	62,000	<1,000
Bis(2-Ethylhexyl)Phthalate	NT	NT	3,300	<820	510	180	27,000	<1,000
Butyl Benzyl Phthalate	NT	NT	<1,600	<820	230	<750	<1,000	<1,000
Chrysene	NT	NT	6,000	1,600	1,800	1,400	19,000	<1,000
Dibenzo(a,h)Anthracene	NT	NT	<4,000	<820	<410	260	<1,000	<1,000
Dibenzofuran	NT	NT	NT	130	140	160	NT	NT
Fluoranthene	NT	NT	13,000	2,800	4,400	2,400	13,000	7,400
Fluorene	NT	NT	1,600	190	250	260	<1,000	<1,000
Indeno(1,2,3-cd)Pyrene	NT	NT	<4000	670	610	660	<1,000	<1,000
2-Methylnaphthalene	NT	NT	NT	<820.0	49	<750	NT	NT
Naphthalene	NT	NT	<1,600	<820.0	49	<750	<1,000	<1,000
Phenanthrene	NT	NT	14,000	2,400	2,900	2,500	11,000	<1,000
Pyrene	NT	NT	9,400	3,500	2,500	3,300	7,300	<1,000
TOTAL SEMIVOLATILES DETECTED			83,400	19,990	23,568	19,660	153,400	10,400
Pesticides and PCBs (ug/kg)								
Aldrin	NT	NT	NT	<10.0	<10.0	<10.0	2.1	2.5
alpha-BHC	NT	NT	NT	<10.0	19.0	<10.0	4.8	14.0
delta-BHC	NT	NT	NT	15.0	53.0	<10.0	<1.0	<1.0
4,4'-DDT	NT	NT	NT	<10.0	<10.0	<10.0	37.0	20.0
Dieldrin	NT	NT	NT	<10.0	<10.0	<10.0	3.9	2.4
Heptachlor	NT	NT	NT	<10.0	<10.0	<10.0	19.0	<1.0
Inorganic Compounds (mg/kg)								
Antimony	NT	NT	<0.02	<0.02	<0.02	<0.02	0.12	<0.02
Arsenic	NT	NT	0.03	0.55	0.80	<0.04	0.165	0.371
Beryllium	NT	NT	<0.1	0.25	0.40	0.41	<0.1	<0.1
Cadmium	NT	NT	0.9	<0.10	1.61	1.55	0.62	0.83
Chromium	NT	NT	3.0	6.71	14.10	11.30	5.20	59.80
Copper	NT	NT	2.39	10.00	29.50	10.50	<0.30	67.80
Cyanide	NT	NT	0.187	NT	NT	NT	<0.16	<0.16
Lead	NT	NT	9.94	25.80	43.10	33.50	11.00	156.00
Mercury	NT	NT	0.45	<0.10	0.093	0.093	0.20	0.15
Nickel	NT	NT	7.74	4.44	6.55	6.55	26.10	39.70
Thallium	NT	NT	<0.02	5.59	5.59	5.59	4.85	3.66
Zinc	NT	NT	129.0	33.60	66.00	59.00	111.00	174.00
Total Phenolics (mg/kg)	NT	NT	0.231	NT	NT	NT	<0.04	<0.04

NT Not tested as part of this study

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

TABLE 3-2

SUMMARY OF ANALYTICAL RESULTS
DECEMBER 1985 SURFACE WATER SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID:	522396	522397	522398
SAMPLE DATE:	12/19/85	12/19/85	12/19/85
SAMPLE NAME:	WA-4	WA-5	WA-4-5
Parameter (Units)			
Volatile Compounds (ug/l)			
Benzene	2.3	2.1	NT
1,1-Dichloroethane	1.9	1.6	NT
Ethylbenzene	2.5	2.6	NT
Toluene	844.0	747.0	NT
1,1,1-Trichloroethane	6.8	6.3	NT
Trichlorofluoromethane	368.0	336.0	NT
TOTAL VOLATILES DETECTED	1,225.5	1,095.6	NT
Inorganic Parameters (mg/l)			
Antimony	NT	NT	0.00
Arsenic	NT	NT	[illegible]
Barium	NT	NT	[illegible]
Chromium	NT	NT	0.00
Copper	NT	NT	0.03
Lead	NT	NT	0.02
Selenium	NT	NT	0.00
Zinc	NT	NT	0.40
Specific Conductance (umhos)	NT	NT	5,916.0

NT Not tested as part of this study

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

TABLE 3-3

SUMMARY OF ANALYTICAL RESULTS
SURFACE SOIL, SEDIMENT, AND WATER QA/QC SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID:	521920	521919	521923	521922	522395	613329	613330
SAMPLE DATE:	12/12/85	12/12/85	12/12/85	12/12/85	12/19/85	07/18/86	07/18/86
SAMPLE ID:	Trip Blank	Field Blank	Trip Blank	Field Blank	Field Blank	Trip Blank	Field Blank
Parameter (Units)							
Volatile Compounds (ug/l)							
Acetone	NT	NT	NT	NT	NT	15.0	240.0
Methylene Chloride	<1.0	<1.0	NT	NT	<10.0	<5.0	<8.0
Trichloroethene	2.2	<1.0	NT	NT	<10.0	<5.0	
Semivolatile Compound (ug/l)							
Bis(2-Ethylhexyl)Phthalate	NT	NT	<10.0	10.0	<10.0	NT	NT
Inorganic Compounds (mg/l)							
Antimony	NT	NT	<0.002	<0.002	0.003	NT	NT
Arsenic	NT	NT	0.005	0.002	<0.002	NT	NT
Cadmium	NT	NT	0.01	0.01	<0.01	NT	NT
Copper	NT	NT	0.09	0.12	<0.03	NT	NT
Zinc	NT	NT	0.07	0.11	0.060	NT	NT
Total Phenolics (mg/l)	NT	NT	<0.01	<0.01	0.074	NT	NT

NT Not tested as part of this study

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

samples (SED-4 and SED-5) collected at locations corresponding to the ponded water samples indicated the presence of organic compounds at levels higher than the water samples. The volatile compounds detected and maximum concentrations were benzene (150 ug/kg), carbon tetrachloride (20 ug/kg), 1,2-dichloroethane (9,110 ug/kg), cis-1,3-dichloropropene (50 ug/kg), ethylbenzene (480 ug/kg), and toluene (4,650 ug/kg). Concentrations of total volatile compounds detected were 3,150 ug/kg in SED-4 and 14,410 ug/kg in SED-5.

Base/neutral extractable organic compounds were detected in both pond sediment samples; eight of these compounds, totalling 153,400 ug/kg, were detected in SED-4 and two of these compounds, totalling 10,400 ug/kg, were detected in SED-5. Maximum concentrations of semi-volatile compounds detected in SED-4 were benzidine (7,300 ug/kg), benzo(b)fluoranthene (6,800 ug/kg), benzo(g,h,i)perylene (3,000 ug/kg), bis(2-chloroethyl)ether (62,000 ug/kg), bis(2-ethylhexyl)phthalate (27,000 ug/kg), chrysene (19,000 ug/kg), fluoranthene (13,000 ug/kg), phenanthrene (11,000 ug/kg), and pyrene (7,300 ug/kg).

Both sediment samples contained several pesticides (total concentrations less than 100.0 ug/kg). Maximum concentrations detected included aldrin (2.5 ug/kg), alpha-BHC (14.0 ug/kg), 4,4-DDT (37.0 ug/kg), dieldrin (3.9 ug/kg), and heptachlor (19.0 ug/kg). Neither sample was found to contain PCBs.

Inorganic analyses were also performed on a composite of the pond water samples (WA-4-5) and the sediment samples. Seven metals were identified in the composite water sample, and nine metals were observed in each of the sediment samples. Sample SED-5 generally contained higher metals concentrations than SED-4, with the highest levels occurring for zinc (174 mg/kg), lead (156 mg/kg), and copper (67.8 mg/kg).

Stream Sediment Samples

The three stream sediment samples were collected from the bed of the unnamed intermittent stream bordering the Site to the east. Sample SED-1 was collected in the hydraulically upgradient direction from the Site and is representative of background stream sediment conditions. Sample SED-2 was collected immediately adjacent to the Site. Sample SED-3 was collected from the intermittent stream in the hydraulically downgradient direction. The samples were analyzed for volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, and metals.

Acetone and methylene chloride were the only volatile compounds detected in the three sediment samples. Acetone was detected in SED-3 at 9.1 ug/kg; methylene chloride was detected in SED-1,SED-2, and SED-3 at 37 ug/kg, 50 ug/kg, and 39 ug/kg, respectively.

Nineteen semi-volatile compounds were detected in the stream sediment samples. The compounds detected and their maximum concentrations include: acenaphthene (250 ug/kg), anthracene (610 ug/kg), benzo(a)anthracene (1,500 ug/kg), benzo(a)pyrene (1,400 ug/kg), benzo(b)fluoranthene (2,900 ug/kg), benzo(k)fluoranthene (2,900 ug/kg), benzo(g,h,i)-perylene (740 ug/kg), bis(2-ethylhexyl) phthalate (510 ug/kg), butyl benzyl phthalate (230 ug/kg), chrysene (1,800 ug/kg), dibenzofuran (160 ug/kg), dibenzo(a,h)anthracene (260 ug/kg), fluoranthene (4,400 ug/kg), fluorene (260 ug/kg), indeno(1,2,3-cd)pyrene (670 ug/kg), 2-methylnaphthalene (49 ug/kg), naphthalene (49 ug/kg), phenanthrene (2,900 ug/kg), and pyrene (3,500 ug/kg). Total concentrations of semi-volatile organic compounds were 19,990 ug/kg, 23,568 ug/kg, and 19,660 ug/kg for SED-1, SED-2, and SED-3, respectively. While the total concentrations of semi-volatile compounds were greatest in the sample obtained adjacent to the Site (SED-2), total semi-volatiles in both the upgradient sediment sample (SED-1) and downgradient sediment sample (SED-3) were detected at similar levels.

Two pesticides, alpha-BHC and delta-BHC, were detected in the stream sediment samples SED-1 and SED-2. Alpha-BHC was detected in the sample obtained adjacent to the site (SED-2) at 19 ug/kg; delta-BHC was detected in the upgradient sediment sample (SED-1) and SED-2 at 15 ug/kg and 53 ug/kg, respectively.

Ten metals were detected in these samples. Two metals, mercury and thallium, were detected at concentrations similar to those detected in the onsite pond sediment samples (SED-4 and SED-5). Five metals were detected in the stream sediments at concentrations lower than those detected in SED-4 and SED-5. These metals and the maximum concentration detected include: chromium (14.1 mg/kg), copper (29.5 mg/kg), lead (43.1 mg/kg), nickel (6.55 mg/kg), and zinc (66 mg/kg). Three metals were detected in the stream sediments at concentrations higher than those detected in SED-4 and SED-5. These metals and their maximum detected concentrations include arsenic (0.80 mg/kg), beryllium (0.40 mg/kg) and cadmium (1.61 mg/kg). The compounds and concentrations detected in the upstream (SED-1) and downstream (SED-3) samples were generally consistent.

3.3.1.2 Landfill Investigation

Fifteen test pits were excavated in May 1986 in a symmetrical pattern around the trash fill area. In accordance with the November 1985 POP, seven samples were collected from six of the test pits. Two aqueous samples were obtained from standing water in test pits 12 and 14 (samples

identify criteria for selection

TP-12 [leachate] and TP-14 [leachate]). Five solid samples, including one sample (TP-2) from the cinder fill and four samples (TP-5, TP-10, TP-11, and TP-14) from the natural soil underlying the fill material, were collected and analyzed for volatile organic compounds, semi-volatile compounds, PCBs, pesticides, and metals. Analytical results for the test pit samples are summarized in Table 3-4. Analytical results for the QA/QC blanks accompanying the samples are summarized in Table 3-5.

Try to map results similar to low conc. gw in RI for mg. well.

Aqueous Samples

Volatile, semi-volatile, inorganic compounds, pesticides, and total phenolics were detected in the two aqueous samples (TP-12 [leachate] and TP-14 [leachate]). Seven volatile compounds were detected in these samples; the volatile compounds and their maximum detected concentrations include benzene (152 micrograms per liter [ug/l]), chloroform (30.2 ug/l), ethylbenzene (52.6 ug/l), tetrachloroethene (34.9 ug/l), toluene (123 ug/l), trans-1,3-dichloropropene (10.3 ug/l), and trichloroethene (14.1 ug/l).

Seventeen semi-volatile compounds were detected in the aqueous samples; the semi-volatile compounds and their maximum detected concentration include: benzo(k)fluoranthene (35 ug/l), bis(2-chloroethoxy)methane (60 ug/l), bis(2-chloroethyl) ether (92 ug/l), bis(2-ethylhexyl) phthalate (24 ug/l), butyl benzyl phthalate (34 ug/l), di-n-butyl phthalate (8.2 ug/l), 2,4-dimethylphenol (20 ug/l), fluoranthene (183 ug/l), fluorene (16 ug/l), hexachlorobenzene (16 ug/l), hexachlorobutadiene (35 ug/l), hexachloroethane (23 ug/l), naphthalene (76 ug/l), nitrobenzene (52 ug/l), n-nitrosodimethylamine (135 ug/l), phenol (19.8 ug/l), and 1,2,3-trichlorobenzene (11 ug/l).

Three pesticides, aldrin, delta-BHC, and 4,4-DDT were detected at maximum concentrations of 16 ug/kg, 9.1 ug/kg, and 3.2 ug/kg, respectively.

Five inorganic constituents, antimony, arsenic, chromium, cyanide, and zinc, were detected at maximum concentrations of 0.008 mg/l, 0.003 mg/l, 0.010 mg/l, 0.080 mg/l, and 0.044 mg/l, respectively. Total phenolics were detected at a maximum concentration of 0.630 mg/l).

Natural Soil Samples

Volatile compounds, semi-volatile compounds, pesticides, and inorganic compounds were detected in the four samples obtained from from natural soil beneath the fill material (TP-5, TP-10, TP-11, and TP-14). Generally, the maximum detected concentrations for the natural soil samples were detected in the sample from TP-14. Eight volatile compounds, benzene, chlorobenzene, chloroform, ethylbenzene, methylene chloride, tetrachloroethene, toluene, and trichloroethene were detected at maximum concentrations of 410 ug/kg, 290 ug/kg, 70 ug/kg, 3,920 ug/kg, 20 ug/kg, 4,100 ug/kg, 3,770 ug/kg, and 2,850 ug/kg, respectively.

TABLE 3-4

SUMMARY OF ANALYTICAL RESULTS
TEST PIT SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID:	608988	608811	608970	608989	608990	608995	608996
SAMPLE DATE:	05/07/86	05/07/86	05/08/86	05/08/86	05/09/86	05/09/86	05/09/86
SAMPLE NAME:	TP-2	TP-5	TP-10	TP-11	TP-14	TP-12	TP-14
SAMPLE TYPE:	CINDER FILL	NATURAL SOIL	NATURAL SOIL	NATURAL SOIL	NATURAL SOIL	LEACHATE*	LEACHATE*
Parameter (Units)							
Volatile Compounds (ug/kg)							
Benzene	<10.0	40.0	<10.0	<10.0	410.0	<1.0	152.(
Chlorobenzene	<10.0	<10.0	<10.0	<10.0	290.0	<1.0	<1.(
Chloroform	<10.0	70.0	<10.0	<10.0	<10.0	<1.0	30.2
Ethylbenzene	330.0	10.0	<10.0	1,740.0	3,920.0	52.6	39.(
Methylene Chloride	20.0	<10.0	<10.0	20.0	20.0	<1.0	<1.(
Tetrachloroethene (PCE)	<10.0	<10.0	<10.0	<10.0	4,100.0	<1.0	34.9
Toluene	130.0	40.0	40.0	<10.0	3,770.0	27.3	123.(
Trans-1,3-Dichloropropene	<10.0	<10.0	<10.0	<10.0	<10.0	<1.0	10.2
Trichloroethene (TCE)	<10.0	<10.0	<10.0	<10.0	2,850.0	<1.0	14.1
TOTAL VOLATILE COMPOUNDS	480.0	160.0	40.0	1,760.0	15,360.0	79.9	403.5
Semivolatile Compounds (ug/kg)							
Benzo(k)Fluoranthene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	23.0	35.(
Bis(2-Chloroethoxy)Methane	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	26.0	60.(
Bis(2-Chloroethyl)Ether	<1,000.0	<1,000.0	<1,000.0	<1,000.0	7,900.0	17.0	92.(
Bis(2-Ethylhexyl)Phthalate	26,000.0	<1,000.0	<1,000.0	<1,000.0	4,000.0	7.4	24.(
Butyl Benzyl Phthalate	<1,000.0	<1,000.0	<1,000.0	<1,000.0	38,000.0	25.0	34.(
Di-n-Butyl Phthalate	<1,000.0	<1,000.0	<1,000.0	<1,000.0	6,000.0	<5.0	8.2
1,2-Dichlorobenzene	<10.0	<10.0	<10.0	<10.0	18,000.0	<1.0	<1.(
1,3-Dichlorobenzene	<10.0	<10.0	<10.0	<10.0	41,000.0	<1.0	<1.(
1,4-Dichlorobenzene	30.0	<10.0	<10.0	<10.0	<10.0	<1.0	<1.(
2,4-Dimethylphenol	<1,000.0	<5.0	<1,000.0	<1,000.0	<1,000.0	<5.0	20.(
2,6-Dinitrotoluene	32,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<5.0	<5.(
Fluoranthene	<1,000.0	<1,000.0	<1,000.0	2,200.0	<1,000.0	104.0	183.(
Fluorene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	16.0	<5.(
Hexachlorobenzene	69,000.0	<1,000.0	<1,000.0	<1,000.0	14,000.0	16.0	<5.(
Hexachlorobutadiene	56,000.0	<1,000.0	<1,000.0	<1,000.0	26,000.0	30.0	35.(
Hexachloroethane	<1,000.0	<1,000.0	<1,000.0	<1,000.0	116,000.0	<5.0	23.(
Naphthalene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	24.0	76.(
Nitrobenzene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	52.0	16.(
N-Nitrosodimethylamine	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<5.0	135.(
N-Nitrosodi-n-Propylamine	<1,000.0	<1,000.0	<1,000.0	<1,000.0	24,000.0	<5.0	<5.(
Phenol	<1,000.0	<5.0	<1,000.0	<1,000.0	<1,000.0	<5.0	19.8
Pyrene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	1,400.0	<5.0	<5.(
1,2,4-Trichlorobenzene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<5.0	11.(
TOTAL SEMIVOLATILE COMPOUND	183,030.0	ND	ND	2,200.0	296,300.0	340.4	772.(
Pesticides and PCBs (ug/kg)							
Aldrin	<1.0	<0.1	<0.1	<0.1	<1.0	16.0	<0.1
delta-BHC	<1.0	<0.1	<0.1	<0.1	<1.0	9.1	<0.1
Chlordane	<1.0	<0.1	<0.1	134.0	<1.0	<0.1	<0.1
4,4'-DDT	<1.0	<0.1	<0.1	<0.1	<1.0	3.1	3.2
PCB-1248	8,300.0	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
PCB-1254	5,500.0	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
Inorganic Compounds (mg/kg)							
Antimony	<0.02	<0.02	<0.02	<0.02	<0.02	0.008	0.00
Arsenic	0.122	0.880	1.970	1.190	2.010	<0.002	0.00
Beryllium	4.750	4.050	11.000	8.900	9.200	<0.01	<0.01
Cadmium	1.650	0.700	2.500	2.500	2.200	<0.01	<0.01
Chromium	198.000	5.400	12.500	26.000	18.500	<0.01	0.01(
Copper	106.000	4.030	15.800	9.620	100.000	<0.02	<0.02(
Cyanide	0.305	0.118	0.087	<0.160	<0.16	0.020	0.08(
Lead	72.200	5.060	19.600	11.500	10.600	<0.002	<0.00
Mercury	0.300	0.100	0.700	0.200	0.200	<0.0002	<0.00(
Nickel	92.500	3.890	13.100	8.900	19.300	<0.1	<0.1
Silver	1.400	<0.200	0.300	0.550	0.300	<0.01	<0.01
Thallium	9.320	<3.000	<3.000	5.000	3.000	<0.3	<0.3
Zinc	335.000	7.500	62.000	33.000	46.500	0.044	0.04
Total Phenolics (mg/kg)	<0.04	<0.13	<0.13	<0.04	<0.04	0.195	0.63(

* Leachate analytical results recorded in mg/l for inorganic compounds and total phenolics and in ug/l for all other results

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

TABLE 3-5

SUMMARY OF ANALYTICAL RESULTS
TEST PIT QA/QC SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID:	608812	608813	608971	608972	608991	608992
SAMPLE DATE:	05/07/86	05/07/86	05/08/86	05/08/86	05/09/86	05/09/86
SAMPLE NAME:	Trip Blank	Field Blank	Trip Blank	Field Blank	Trip Blank	Field Blan
Parameter (Units)						
Volatile Compounds (ug/l)						
Chloroform	<1.0	8.4	<1.0	<1.0	<1.0	<1.0
Ethylbenzene	4.0	4.3	<1.0	<1.0	13.2	<1.0
Methylene Chloride	2.1	<1.0	1.1	<1.0	<1.0	<1.0
Toluene	2.0	<1.0	<1.0	<1.0	<1.0	<1.0

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

Twelve semi-volatile compounds were detected in samples TP-11 and TP-14 which were obtained from the natural soil beneath the fill material. These compounds and the maximum detected concentrations include bis(2-chloroethyl)ether (7,900 ug/kg), bis(2-ethylhexyl)phthalate (4,000 ug/kg) butyl benzyl phthalate (38,000 ug/kg), di-n-butyl phthalate (6,000 ug/kg), 1,2-dichlorobenzene (18,000 ug/kg), 1,3-dichlorobenzene (41,000 ug/kg), fluoranthene (2,200 ug/kg), hexachlorobenzene (14,000 ug/kg), hexachlorobutadiene (26,000 ug/kg), hexachloroethane (116,000 ug/kg), n-nitrosodipropylamine (24,000 ug/kg), and pyrene (1,400 ug/kg). One pesticide, chlordane, was detected in TP-11 at 134.0 ug/kg.

Twelve inorganic compounds were detected in the natural soil beneath the fill. The 12 inorganic compounds and the maximum concentrations detected are as follows: arsenic (1.97 mg/kg), beryllium (11.0 mg/kg), cadmium (2.5 mg/kg), chromium (26.0 mg/kg), copper (106 mg/kg), cyanide (0.118 mg/kg), lead (19.6 mg/kg), mercury (0.7 mg/kg), nickel (19.3 mg/kg), silver (0.55 mg/kg), thallium (5.0 mg/kg), and zinc (62.0 mg/kg).

Cinder Fill Sample

The sample obtained from cinder fill material at TP-12 contained volatile compounds, semi-volatile compounds, PCBs, inorganic compounds, and total phenolics. Three volatile compounds, ethylbenzene, methylene chloride, and toluene were detected at 330 ug/kg, 20 ug/kg, and 130 ug/kg, respectively. Five semi-volatile compounds, bis(2-ethylhexyl) phthalate, 1,4-dichlorobenzene, 2,6-dinitrotoluene, hexachlorobenzene, and hexachlorobutadiene, were detected at 26,000 ug/kg, 30 ug/kg, 32,000 ug/kg, 69,000 ug/kg, and 56,000 ug/kg, respectively. Two PCBs, PCB-1248 and PCB-1254, were detected at 8,300 ug/kg and 5,500 ug/kg, respectively. Twelve metals, arsenic (0.122 mg/kg), beryllium (4.75 mg/kg), cadmium (1.65 mg/kg), chromium (198.0 mg/kg), copper (06 mg/kg), cyanide (0.305 mg/kg), lead (72.2 mg/kg), mercury (0.30 mg/kg), nickel (92.5 mg/kg), silver (1.40 mg/kg), thallium (9.32 mg/kg), and zinc (335.0 mg/kg) were detected in the cinder fill material.

3.3.2 Additional Landfill Investigation

3.3.2.1 General

Whereas the July 1986 test pits had been positioned in a symmetrical pattern, borings completed during the additional landfill investigation were specifically placed at locations potentially thought to have or have generated contamination. Boring B-1 was located approximately 10 feet

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south of Test Pit No. 1 (TP-1) where elevated air monitoring readings (OVA) were recorded in May 1986. Borings B-2 and B-2A were located between Test Pits TP-2 and TP-7 in an area where trenching activities and disposal of liquids or sludges had reportedly occurred. Borings B-3 and B-3A were located along the southern edge of the lined retention pond located in the western side of the landfill. The retention pond, which was constructed to contain groundwater from the August 1986 pump test, is located in a topographically low area where surface water formerly tended to pond and where elevated concentrations of contaminants were detected in surface water and sediment samples obtained in July 1986. Boring B-4, the background boring, was located approximately 6 feet east of monitoring well HR-1-276.

Samples were obtained from borings from natural soil beneath the fill material at varying intervals (immediately beneath the fill material, an intermediate depth approximately 10 feet beneath the base of the fill material, and from soil just above the bedrock surface, if bedrock was encountered within 50 feet of the surface) to further characterize contamination associated with the LOU and potential migration pathways, to develop a data base for a fate and transport analysis, and to support the identification and analysis of remedial action technologies.

Twelve soil samples (nine samples from natural soil beneath the fill material, two natural soil samples from the background borings and one from cinder fill material) were obtained by BCM and analyzed by the EPA for chemical analyses; seven soil samples, splits of samples analyzed by EPA were obtained for volatile organic analyses by BCM, and 10 samples were obtained for physical/chemical parameter testing by BCM. Samples were taken on November 19 through November 24, 1987, from six test borings (B-1, B-2, B-2A, B-3, B-3A, and B) at the Site (Figure 2-1). The soil samples were collected in accordance with the sampling rationale outlined in the November 1987 Work Plan. A summary of soil sample information, including field identification names, laboratory identification numbers, sampling dates, and analyses performed, is contained in Table 3-6. (as amended January —, 1988.

Soil samples obtained during the November 1987 sampling event were labeled with field identification names according to the analytical tests to be performed on the samples. The samples were labeled in accordance with the following rationale:

- Soil samples to be analyzed by the EPA Region III Central Regional Laboratory (CRL) or EPA subcontracted laboratory were labeled "BHXY," where: "B" identifies the sample as from a boring; "H" identifies the origin of the sample as Henderson Road; "X" represents the boring number; and "Y," which was A, B, or C, represents the order in which the sample was obtained from a particular boring.

TABLE 3-6

SAMPLE SUMMARY TABLE
ADDITIONAL LANDFILL INVESTIGATION

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

SAMPLE LOCATION (Boring Number [Depth, ft.])	BCM SAMPLE NAME	EPA SAMPLE NAME	BCM LABORATORY ID	EPA LABORATORY ID	SAMPLE DATE	ANALYSES PERFORMED
B-1(14-15.5)	--	BH1A	--	871120-01; MCK871	11/19/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-1(14-15.5)	B-1(14-15.5)	--	728651	--	11/19/87	VOL (methanol method)
B-1(16-18)	B-1(ST-1)	--	730557	--	11/19/87	Physical/chemical parameter tests
B-1(30-31.5)	--	BH1B	--	871120-02; MCK872	11/19/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-1(31.5-33.5)	B-1(ST-2)	--	730558	--	11/19/87	Physical/chemical parameter tests
B-2(14.5-16)	--	BH2A	--	871123-01; MCR221	11/20/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-2(14.5-16)	B-2(14.5-16)	--	728742	--	11/20/87	VOL (methanol method)
B-2(16-18)	B-2(ST-1)	--	730559	--	11/20/87	Physical/chemical parameter tests
B-2(30-31.5)	--	BH2B	--	871123-02; MCR197	11/20/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-2(32-34)	B-2(ST-2)	--	730560	--	11/20/87	Physical/chemical parameter tests
B-2A(40-41.5)	--	BH6A	--	871125-05; MCR228	11/24/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-2A(40-41.5)	B-2A(40-41.5)	--	728894	--	11/24/87	VOL (methanol method)
B-2A(41.5-43.5)	B-2A(ST-3)	--	730561	--	11/24/87	Physical/chemical parameter tests
B-3(19-20.5)	--	BH3A	--	871124-01; MCR222	11/23/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-3(20.5-22.5)	B-3(ST-1)	--	730562	--	11/23/87	Physical/chemical parameter tests
B-3(30-31.5)	--	BH3B*	--	871124-02; MCR223	11/23/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-3(30-31.5)	--	BH5*	--	871124-03; MCR224	11/23/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-3(30-31.5)	B-3(30-31.5)*	--	728819	--	11/23/87	VOL (methanol method)
B-3(30-31.5)	B-3D(30-31.5)*	--	728820	--	11/23/87	VOL (methanol method)
B-3(31.5-33.5)	B-3(ST-2)	--	730563	--	11/23/87	Physical/chemical parameter tests
B-3(47-48.5)	--	BH3C	--	871124-04; MCR225	11/23/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-3(48.5-50.5)	B-3(ST-3)	--	730564	--	11/23/87	Physical/chemical parameter tests
B-3A(4-5.5)	--	BH7A	--	871125-06; MCR229	11/24/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-3A(4-5.5)	B-3A(4-5.5)	--	728895	--	11/24/87	VOL (methanol method)
B-4(6-7.5)	--	BH4A	--	871125-01; MCR226	11/24/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-4(7.5-9.5)	B-4(ST-1)	--	730565	--	11/24/87	Physical/chemical parameter tests
B-4(17.5-19)	--	BH4B	--	871125-02; MCR227	11/24/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
B-4(17.5-19)	B-4(17.5-19)	--	728893	--	11/24/87	VOL (methanol method)
B-4(19-21)	B-4(ST-2)	--	730566	--	11/24/87	Physical/chemical parameter tests
--	TRIP BLANK	--	728650	--	11/19/87	VOL (methanol method)
--	TRIP BLANK	--	728896	--	11/24/87	VOL (methanol method)
--	--	TRIP BLANK	--	871120-03	11/19/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
--	--	FIELD BLANK	--	871120-04	11/19/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
--	--	TRIP BLANK	--	871124-05	11/23/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
--	--	FIELD BLANK	--	871124-06	11/23/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
--	--	TRIP BLANK	--	871125-03	11/24/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)
--	--	FIELD BLANK	--	871125-04	11/24/87	TCL VOL, BNA, inorganics, pesticides and PCBs; VOL (methanol method)

-- Not applicable
* B-3D(30-31.5) is a duplicate of B-3(30-31.5); BH5 is a duplicate of BH3B
TCL Target compound list
VOL Volatile organic compounds. VOL (methanol method) indicates that the sample was analyzed for volatile organic compounds using modified sampling and analytical procedures for the methanol method.
BNA Semivolatile organic compounds (base/neutral and acid extractable compounds)

Source: BCM Engineers (BCM Project No. 00-5808-01)

- Soil samples retained for volatile organic analyses by BCM were labeled "B-X (XX-XX)," where: "B" is an identifier representing a test boring; "X" identifies the boring number; and "(XX-XX)" identifies the interval the sample was obtained from, in feet below the ground surface.

- Soil samples retained for physical/chemical parameter testing by BCM were labeled "B-X (ST-X)," where: "B" represents a test boring; "X" identifies the boring number; "ST" identifies the use of a Shelby Tube to obtain the sample; and the second "X", which was a 1, 2, or 3, represents the order in which the Shelby Tube sample was obtained from the boring.

Twelve soil samples (BH1A, BH1B, BH2A, BH2B, BH3A, BH3B, BH3C, BH4A, BH4B, BH5, BH6A, and BH7A) were analyzed by the EPA or an EPA subcontracted laboratory for Target Compound List (TCL) volatile organic compounds, TCL semi-volatile organic compounds, and TCL inorganic parameters. The samples were collected and analyzed for the volatile organic compounds using two methods, the standard contract laboratory program method and a modified sampling procedure (methanol method). Analytical parameters and procedures for these methods are contained in the November 1987 Work Plan. A summary of EPA analytical results is contained in Table 3-7.

Due to the experimental status of the methanol method, seven split samples (B-1 [14-15.5], B-2 [14.5-16], B-2A [40-41.5], B-3 [30-31.5], B-3D [30-31.5], B-3A [4-5.5], and B-4 [17.5-19]) were analyzed for volatile organic compounds by BCM to confirm the results obtained by the EPA. These samples were obtained using the modified sampling procedure for soils. A summary of the analytical results is contained in Table 3-8.

To obtain site specific information for the fate and transport assessment, ten soil samples B-1 (ST-1), B-1 (ST-2), B-2 (ST-1), B-2 (ST-2), B-2A (ST-3), B-3 (ST-1), B-3 (ST-2), B-3 (ST-3), B-4 (ST-1), and B-4 (ST-2) were analyzed by BCM or a BCM subcontracted laboratory for the physical/chemical parameter tests. A summary of the analytical results is contained in Table 3-9.

3.3.2.2 Chemical Analyses - EPA Results

Volatile Organic Compounds - Standard CLP Method

Twelve soil samples, including field duplicates BH3B and BH5, and three field blanks of ultrapure distilled/deionized water all containerized using standard preservation procedures, were analyzed by the EPA CRL for TCL volatile organic compounds plus 15 tentatively identified compounds by gas chromatography/mass spectroscopy (GC/MS) (EPA Method 624 for

TABLE 3-7

SUMMARY OF ANALYTICAL RESULTS
EPA ANALYSES OF NOVEMBER 1987 SOIL SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

EPA LABORATORY ID:	871120-01 MCK871	871120-02 MCK872	871123-01 MCR221	871123-02 MCR197	871125-05 MCR228	871124-01 MCR222
SAMPLE DATE:	11/19/87	11/19/87	11/20/87	11/20/87	11/24/87	11/23/87
EPA SAMPLE NAME:	BH1A	BH1B	BH2A	BH2B	BH6A	BH3A
SAMPLE LOCATION:	B-1(14-15.5)	B-1(30-31.5)	B-2(14.5-16)	B-2(30-31.5)	B-2A(40-41.5)	B-3(19-20.5)
SAMPLE TYPE:	Natural Soil	Natural Soil	Natural Soil	Natural Soil	Natural Soil	Natural Soil
Parameter (Units)						
Volatile Compounds*	ND	ND	ND	ND	ND	ND
Semivolatile Compounds** (ug/kg)						
4-Methylphenol	<830	<820	<830	<830	<1,000	20 J
Diethylphthalate	<830	<820	<830	<830	<1,000	56
Phenanthrene	30 J	<820	20 J A	<830	<1,000	56
Anthracene	<830	<820	<830	<830	<1,000	5 A
Di-n-butylphthalate	<830	NC	<830	<830	NC	NC
Fluoranthene	60	<820	28 J A	<830	<1,000	46
Pyrene	50	<820	35 J A	<830	<1,000	28
Butylbenzylphthalate	<830	<820	<830	<830	<1,000	<990
Benzo(a)Anthracene	<830	<820	<830	<830	<1,000	<990
Bis(2-ethylhexyl)Phthalate	NC	NC	NC	NC	NC	NC
Chrysene	<830	<820	60 J A	<830	<1,000	<990
Di-n-octylphthalate	<830	NC	<830	NC	<1,000	<990
TOTAL SEMIVOLATILE COMPOUNDS	140	ND	110	ND	ND	185
Pesticides and PCBs (ug/kg)	ND	ND	ND	ND	ND	ND
Inorganic Parameters (mg/kg)						
Aluminum	6,580 J	17,300 J	24,600 J	15,700 J	11,000 J	10,700 J
Antimony	<6.1 R	<6.7	<6.7	<6.6 R	<6.5 R	<6.4 R
Arsenic	<1.6	6.4	6.4	14	16	12
Barium	18 J	50	80	40	66	9.8 J
Beryllium	<1.1	7.4 J	<1.2	2.7 J	6.0	1.8 J
Cadmium	3.2 J	8.6	5.6	7.5	8.1	9.7
Calcium	1,190	1,100	1,610	454 J	730	894
Chromium	9.8	17	35	12	11	17
Cobalt	2.1 J	12 J	6.9	17	30	15
Copper	13 J	46 J	17 J	54 J	47 J	44 J
Cyanide	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Iron	14,900	39,800	29,200	38,600	35,200	49,800 J
Lead	10	13 J	23 R	21	18	34
Magnesium	586	1,110	2,780	560	617	564
Manganese	60	718	271	801	1,210	109
Mercury	<0.11	<0.12	<0.12	<0.12	<0.12	<0.12
Nickel	7.5 J	34	22	47	54	32
Potassium	1,400 J	883 J	1,470 J	736 J	721 J	372 J
Selenium	<0.68 UL	<0.74 UL	<0.74 UL	<0.73 UL	<0.72 UL	<0.71 UL
Silver	<1.6	<1.7	<1.7	<1.7	<1.7	<1.7
Sodium	384 J	270 J	493 J	270 J	266 J	252 J
Thallium	<1.6 UL	<1.7 UL	<1.7 UL	<1.7 UL	<1.7 UL	<1.7 UL
Vanadium	15	34	52	28	19	34
Zinc	18	108	54	155	125	94
Tentatively Identified Compounds (mg/kg)						
Hexane, 2,4-Dimethyl-	0.04 A	ND	ND	ND	ND	ND
Octane, 3-Ethyl-2,7-Dimethyl-	0.04 A	ND	ND	ND	ND	ND
Hexadecanoic Acid	0.3	ND	ND	ND	ND	ND
Cyclopropane, Octyl-	0.1	ND	ND	ND	ND	ND
Nonane, 3,7-Dimethyl-	0.08 A	ND	ND	ND	ND	ND
Propanoic Acid, 3,3'-Thiobis-, Didodecyl ester	5.2	4.5	3.5	8.4	ND	ND
Pyrrolidine	ND	0.08 A	ND	ND	ND	ND
Aziridine, 1-Propyl-	ND	0.1	ND	ND	ND	ND
2-Propenoic Acid, Octyl Ester	ND	0.3	ND	ND	ND	ND
Hexanedioic Acid, Dioctyl Ester	ND	9.1	5.1	4.4	ND	ND
Octane, 2,4,6-Trimethyl-	ND	0.3 B	0.6 B	ND	ND	ND
Benzene, (1,1-Dimethylethyl)-	ND	ND	0.07 A	ND	ND	ND
Decane, 2,4-Dimethyl-	ND	ND	0.03 A	ND	ND	ND
Decane, 2,5,9-Trimethyl-	ND	ND	0.1	ND	ND	ND
1-Heptanol, 2-Propyl-	ND	ND	0.1	ND	ND	ND
Hydroxylamine, o-Decyl-	ND	ND	0.06 A	ND	ND	ND
1-Decanol, 2-Ethyl-	ND	ND	0.1	ND	ND	ND
3-Hexene, 2,5-Dione-	ND	ND	ND	0.2	ND	ND
2-Pentanol, 2,4-Dimethyl-	ND	ND	ND	0.2	ND	ND
Butane, 1-Chloro-3-Methyl-	ND	ND	ND	0.03 A	ND	ND
Nitric Acid, Hexyl Ester	ND	ND	ND	0.06 A	ND	ND
Undecane	ND	ND	ND	ND	ND	ND
Octane, 2,3,7-Trimethyl-	ND	ND	ND	ND	ND	ND
Decane, 3-Bromo-	ND	ND	ND	ND	ND	ND
Nonane, 2-6-Dimethyl-	ND	ND	ND	ND	ND	ND
1H-Indene, Octahydro-2,2,4,4,7,7-Hexamethyl-, trans-	ND	ND	ND	ND	ND	ND
Undecane, 4,6-Dimethyl-	ND	ND	ND	ND	ND	ND
Nonane, 3,7-Dimethyl-	ND	ND	ND	ND	ND	ND
Dodecane, 2,6,11-Trimethyl-	ND	ND	ND	ND	ND	ND
Undecane, 4,7-Dimethyl-	ND	ND	ND	ND	ND	ND
Dodecane, 2,7,10-Trimethyl-	ND	ND	ND	ND	ND	ND
Unknown	ND	ND	1.2	2.8	ND	ND

* Detection limits for volatile compounds ranged from 20 to 40 ug/kg for samples analyzed using the standard CLP method and from 10,000 to 20,000 ug/kg for samples analyzed using modified sampling and analysis for the methanol method

** Detection limits for semivolatile compounds were computed by multiplying the nominal quantitation limit for the compound by the sample specific dilution/concentration ratio

A Result also listed as trace

B Tentatively identified compound listed more than once; highest detected concentration is reported

J For organic compounds: Estimated quantity; concentration below the level for accurate quantitation
For inorganic compounds: Compound present; reported concentration may not be accurate or precise

NC Not detected after correction for laboratory blanks

ND Not detected

R Unreliable result; compound may or may not be present

UL Not detected; quantitation limit is probably higher

Sample Location = Boring number (sample depth in feet below surface)

Source: EPA Region III Central Regional Laboratory
Compiled by: BCM Engineers (BCM Project No. 00-5808-01)

Table 3-7 (Cont'd)

EPA LABORATORY ID:	871124-02 MCR223	871124-03 MCR224	871124-04 MCR225	871125-06 MCR229	871125-01 MCR226	871125-02 MCR227
SAMPLE DATE:	11/23/87	11/24/87	11/23/87	11/24/87	11/24/87	11/24/87
EPA SAMPLE NAME:	BH3B	BH5	BH3C	BH7A	BH4A	BH4B
SAMPLE LOCATION:	B-3(30-31.5)	B-30(30-31.5)	B-3(47-48.5)	B-3A(4-5.5)	B-4(6-7.5)	B-4(17.5-19)
SAMPLE TYPE:	Natural Soil	Natural Soil	Natural Soil	Cinder Fill	Background	Background
Parameter (Units)						
Volatile Compounds*	ND	ND	ND	ND	ND	ND
Semivolatile Compounds** (ug/kg)						
4-Methylphenol	<900	<1,000	<890	<1,000	<1,000	<1,000
Diethylphthalate	20	10	<890	<1,000	<1,000	<1,000
Phenanthrene	<900	<1,000	<890	100 J	<1,000	<1,000
Anthracene	<900	<1,000	<890	<1,000	<1,000	<1,000
Di-n-butylphthalate	<900	NC	<890	<1,000	<1,000	<1,000
Fluoranthene	<900	<1,000	<890	200 J	<1,000	<1,000
Pyrene	<900	<1,000	<890	300 J	<1,000	<1,000
Butylbenzylphthalate	<900	<1,000	<890	40 J	<1,000	<1,000
Benzo(a)Anthracene	<900	<1,000	<890	200 J	<1,000	<1,000
Bis(2-ethylhexyl)Phthalate	NC	NC	<890	<1,000	<1,000	NC
Chrysene	<900	<1,000	<890	<1,000	<1,000	<1,000
Di-n-octylphthalate	<900	<1,000	<890	<1,000	<1,000	<1,000
TOTAL SEMIVOLATILE COMPOUNDS	20	10	ND	840	ND	ND
Pesticides and PCBs (ug/kg)	ND	ND	ND	ND	ND	ND
Inorganic Parameters (mg/kg)						
Aluminum	7,700 J	14,400 J	2,330 J	7,270 J	14,800 J	12,300 J
Antimony	6.5 R	6.4 R	6.3 R	6.1 R	6.3 R	6.4 R
Arsenic	6.6	4.5 J	15	8.5	5.1	10
Barium	16 J	25 J	116	253	34	24
Beryllium	2.2 J	2.2 J	5.3 J	1.6 J	<1.2	3.2 J
Cadmium	8.6	8.3	17	2.7 J	5.3	6.5
Calcium	456 J	686	422 J	39,600	1,430	604
Chromium	6.4 J	10	4 J	13	36	9.3
Cobalt	10	22	40	5.2 J	11	16
Copper	43 J	69 J	36 J	48 J	23 J	65 J
Cyanide	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Iron	48,300	50,900	77,800	9,410	30,000	36,600
Lead	5.3 J	36	26	61	10 J	54
Magnesium	499	671	467	13,600	1,990	713
Manganese	322	536	4,930	428	541	979
Mercury	<0.12	<0.12	0.12 J	1.0	<0.12	<0.12
Nickel	36	50	87	14	16	45
Potassium	833 J	858 J	871 J	719 J	838 J	713 J
Selenium	<0.72 UL	<0.70 UL	<0.70 UL	<0.67 UL	<0.70 UL	<0.71 UL
Silver	<1.7	<1.6	<1.6	<1.6	<1.6	<1.7
Sodium	248 J	236 J	263 J	476	268 J	247 J
Thallium	<1.7 UL	<1.6 UL	<1.6 UL	<1.6 UL	<1.6 UL	<1.7 UL
Vanadium	14	23	16	17	39	18
Zinc	158	205	254	256	42	167
Tentatively Identified Compounds (mg/kg)						
Hexane, 2,4-Dimethyl-	NC	NC	NC	ND	NC	NC
Octane, 3-Ethyl-2,7-Dimethyl-	NC	NC	NC	0.08 A B	NC	NC
Hexadecanoic Acid	NC	NC	NC	NC	NC	NC
Cyclopropane, Octyl-	NC	NC	NC	NC	NC	NC
Hexane, 3,3-Dimethyl-	NC	NC	NC	NC	NC	NC
Propanoic Acid, 3,3'-Thiobis-, Didodecyl ester	NC	NC	NC	NC	NC	NC
Pyrrolidine	NC	NC	NC	NC	NC	NC
Aziridine, 1-Propyl-	NC	NC	NC	NC	NC	NC
2-Propenoic Acid, Octyl Ester	NC	NC	NC	NC	NC	NC
Hexanedioic Acid, Dioctyl Ester	NC	NC	NC	NC	NC	NC
Octane, 2,4,6-Trimethyl-	NC	NC	NC	0.9 B	NC	NC
Benzene, (1,1-Dimethylethyl)-	NC	NC	NC	NC	NC	NC
Decane, 2,4-Dimethyl-	NC	NC	NC	NC	NC	NC
Decane, 2,5,9-Trimethyl-	NC	NC	NC	NC	NC	NC
1-Heptanol, 2-Propyl-	NC	NC	NC	NC	NC	NC
Hydroxylamine, o-Decyl-	NC	NC	NC	NC	NC	NC
1-Decanol, 2-Ethyl-	NC	NC	NC	NC	NC	NC
3-Hexene, 2,5-Diene-	NC	NC	NC	NC	NC	NC
2-Pentanol, 2,4-Dimethyl-	NC	NC	NC	NC	NC	NC
Butane, 1-Chloro-3-Methyl-	NC	NC	NC	NC	NC	NC
Nitric Acid, Hexyl Ester	NC	NC	NC	NC	NC	NC
Undecane	NC	NC	NC	0.1	NC	NC
Octane, 2,3,7-Trimethyl-	NC	NC	NC	0.2	NC	NC
Decane, 3-Bromo-	NC	NC	NC	0.05 A	NC	NC
Hexane, 2-6-Dimethyl-	NC	NC	NC	0.2	NC	NC
1H-Indene, Octahydro-2,2,4,4,7,7-Hexamethyl-, trans-	NC	NC	NC	0.1 A	NC	NC
Undecane, 4,6-Dimethyl-	NC	NC	NC	0.5	NC	NC
Hexane, 3,3-Dimethyl-	NC	NC	NC	0.07 A	NC	NC
Dodecane, 2,6,11-Trimethyl-	NC	NC	NC	0.4	NC	NC
Undecane, 4,7-Dimethyl-	NC	NC	NC	1.0 B	NC	NC
Dodecane, 2,7,10-Trimethyl-	NC	NC	NC	0.9 B	NC	NC
Unknown	NC	NC	2.0	NC	NC	NC

* Detection limits for volatile compounds ranged from 20 to 40 ug/kg for samples analyzed using the standard CLP method and from 10,000 to 20,000 ug/kg for samples analyzed using modified sampling and analysis for the methanol method

** Detection limits for semivolatile compounds were computed by multiplying the nominal quantitation limit for the compound by the sample specific dilution/concentration ratio

A Result also listed as trace

B Tentatively identified compound listed more than once; highest detected concentration is reported

J For organic compounds: Estimated quantity; concentration below the level for accurate quantitation
For inorganic compounds: Compound present; reported concentration may not be accurate or precise

NC Not detected after correction for laboratory blanks

ND Not detected

R Unreliable result; compound may or may not be present

UL Not detected; quantitation limit is probably higher

Sample Location = Boring number (sample depth in feet below surface)

Source: EPA Region III Central Regional Laboratory
Compiled by: BCM Engineers (BCM Project No. 00-5808-01)

TABLE 3-8

SUMMARY OF ANALYTICAL RESULTS
BCM VOLATILE ORGANIC ANALYSES OF NOVEMBER 1987 SOIL SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

BCM LABORATORY ID:	728651	728742	728894	728819	728820	728895	728893	728650	728896
SAMPLE DATE:	11-19-87	11-20-87	11-24-87	11-23-87	11-23-87	11-24-87	11-24-87	11-19-87	11-24-87
BCM SAMPLE NAME:	B-1(14-15.5)	B-2(14.5-16)	B-2A(40-41.5)	B-3(30-31.5)	B-3D(30-31.5)	B-3A(4-5.5)	B-4(17.5-19)	Trip Blank*	Trip Blank*
SAMPLE TYPE:	Natural Soil	Natural Soil	Natural Soil	Natural Soil	Natural Soil	Cinder Fill	Background		
Parameter (Units)									
Volatile Compounds (ug/kg)									
Chloromethane	13 J	15.6 J	91 J	85 J	27 J	124	24 J	121	43 J
Methylene Chloride	55 B J	43 B J	<100	<100	<100	<100	<100	<100	<100
Acetone	963	1,010	1,193	1,896	1,070	1,046	949	1,500	984
Chloroform	557	534	702	515	560	604	584	569	609
2-Butanone	3,018	2,766	4,099	3,171	3,730	3,502	3,418	3,130	3,150
Benzene	179	166	229	161	264	206	173	179	179
Toluene	1,126	1,208	1,667	1,200	1,255	1,459	1,304	1,312	1,342
Ethylbenzene	126	102	137	100	104	117	109	109	112
Total Xylenes	406	320	466	290	325	408	366	335	379
Tentatively Identified Compounds (ug/kg)									
Methyl ester propanoic acid	130	140	170	ND	290	150	170	140	150
Tetrahydrofuran	330	ND	ND	ND	ND	ND	ND	ND	ND
Noname	ND	820	1,300	276	990	930	880	ND	1,100
4,5-Dimethyl oxazole	ND	ND	ND	23	ND	ND	ND	ND	ND
Dimethyl ester carbonic aci	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-methyl tetrahydrofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND
Unknown	ND	ND	ND	ND	ND	ND	ND	ND	ND

* - Results for trip blanks reported in ug/l
J - Estimated quantity, concentration below the level for accurate quantitation
B - Compound detected in laboratory blank; possible/probable blank contamination

Source: BCM Engineers (BCM Project NO. 00-5808-01)

TABLE 3-9

RESULTS OF PHYSICAL/CHEMICAL PARAMETER TESTING
NOVEMBER 1987 SOIL SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

BCH LABORATORY ID:	730557	730558	730559	730560	730561	730562	730563	730564	730565	730566
SAMPLE DATE:	11/19/87	11/19/87	11/20/87	11/20/87	11/24/87	11/23/87	11/23/87	11/23/87	11/24/87	11/24/87
SAMPLE NAME:	B-1(ST-1)	B-1(ST-2)	B-2(ST-1)	B-2(ST-2)	B-2A(ST-3)	B-3(ST-1)	B-3(ST-2)	B-3(ST-3)	B-4(ST-1)	B-4(ST-2)
SAMPLE LOCATION:	B-1(16-18)	B-1(31.5-33.5)	B-2(16-18)	B-2(32-34)	B-2A(41.5-43.5)	B-3(20.5-22.5)	B-3(31.5-33.5)	B-3(48.5-50.5)	B-4(7.5-9.5)	B-4(19-21)
Parameter (Units)										
pH (stnd units)	7.5	6.6	7.0	5.4	6.4	7.5	6.8	6.4	6.7	6.0
Total Organic Carbon (mg/kg)	2,540.0	950.0	7,750.0	1,040.0	845.0	1,150.0	1,660.0	167.0	2,190.0	1,540.0
Cation Exchange Capacity (meq/100g)	4.7	5.2	4.3	4.6	4.3	4.1	3.5	3.4	7.8	4.1
Natural Water Content (%)	16.4	20.6	22.2	20.9	21.8	26.9	21.8	18.5	18.7	21.5
Unit Dry Weight (pcf)	113.5	106.8	105.9	98.5	104.4	95.6	99.3	108.1	111.7	103.0
Specific Gravity	2.74	2.78	2.83	2.77	2.67	2.74	2.74	2.79	2.70	2.77
Permeability Tests										
Initial Moisture Content (%)	16.4	20.6	22.2	20.9	21.8	26.9	21.8	18.5	18.7	21.5
Dry Density (pcf)	113.5	106.8	105.9	98.5	104.4	95.6	99.3	108.1	111.7	103.0
Initial Degree of Saturation (%)	88.8	91.9	94.5	77.8	97.9	93.6	83.0	84.8	99.4	87.9
Initial Porosity (%)	33.6	38.4	40.2	42.8	37.6	44.1	41.7	37.7	33.8	40.3
Final Moisture Content (%)	17.5	21.5	22.5	23.7	22.2	28.2	25.0	20.9	19.3	23.2
Final Degree of Saturation (%)	99.0	97.5	96.4	96.7	99.5	97.8	97.5	96.5	100.0	98.2
Coefficient of Permeability (cm/sec)	1.22E-06	2.12E-06	7.08E-07	2.58E-05	4.67E-06	1.28E-05	2.14E-05	1.19E-05	7.93E-07	1.32E-05

Source: BCH Engineers (BCH Project No. 00-5808-01)

aqueous samples; EPA Method 8240 for solid samples). A summary of soil analytical results from these chemical analyses is contained in Table 3-7. No TCL volatile compounds were detected in the soil samples at concentrations above the method detection limit which ranged from 20 to 40 ug/kg. Methylene chloride, 2-butanone, benzene, chloroform, toluene, and m-xylene were detected in the trip blanks.

Volatile Organic Compounds - Methanol Method

In RI discuss why methanol method used; related det. limits to objective for analysis

Twelve soil samples were obtained using modified sampling procedures for the methanol method from the same sample intervals as the samples collected using standard sampling procedures. The soil samples and three trip blanks of reagent grade methanol were analyzed by the EPA Region III CRL for TCL volatile organic compounds. Analytical results are summarized in Table 3-7. No volatile organics were detected in any of the soil samples at concentrations above the method detection limit which ranged from 10,000 to 20,000 ug/kg. Although these reported method detection limits are high, method detection limits reported for the split samples which were analyzed for volatile organic compounds using standard CLP methods ranged from 20 to 40 ug/kg. No volatile organic compounds were detected in the soil samples which could be attributed to the samples. Methylene chloride, 2-butanone, benzene, chloroform, toluene, and m-xylene were detected in the trip blanks at low concentrations.

Semi-volatile Organic Compounds

what concentrations?

The 12 soil samples were analyzed by EPA for TCL semi-volatile organic compounds. Analytical results are summarized in Table 3-7. Eleven semi-volatile compounds (4-methylphenol, diethyl phthalate, phenanthrene, anthracene, fluoranthene, pyrene, butyl benzyl phthalate, benzo(a)anthracene, and chrysene) were detected in six of the samples at concentrations ranging from 5 milligrams per kilogram (ug/kg) to 300 ug/kg. No semi-volatile compounds were detected in the background samples. With the exception of diethylphthalate, which was detected in sample BH3B at 20 ug/kg, semi-volatile compounds were only detected in the natural soil samples obtained immediately beneath the fill material. These results indicate the decrease in concentration or absence of semi-volatile compounds with depth in the soil beneath the fill material.

9 ks,

As a result of a comparison of sample spectra to the EPA/NIH Mass Spectral Library for compounds not on TCL, 32 tentatively identified compounds were detected in five of the samples at estimated concentrations ranging from 0.03 milligrams per kilogram (mg/kg) to 9.1 mg/kg.

Pesticides and PCBs

No pesticides or PCBs were detected in any of the 12 soil samples.

Inorganic Parameters

Results of the inorganic analytical results are summarized in Table 3-7. Generally, the inorganic parameters were detected at concentrations similiar to or less than levels detected in the background samples (BH4A and BH4B). The maximum reported concentrations of inorganics detected in the soil at levels at least two times greater than background levels include barium (253 mg/kg), cadmium (17 mg/kg), calcium (39,600 mg/kg), magnesium (13,600 mg/kg, manganese (4,930 mg/kg), and mercury (1.0 mg/kg).

3.3.2.3 Chemical Analyses - BCM Results

Seven soil samples, including field duplicates B-3 (30-31.5) and B-3D (30-31.5), were collected using modified sampling procedures for the methanol method and analyzed by BCM for volatile organic compounds. Analytical results are summarized in Table 3-8. These seven samples are splits of samples collected using the modified sampling procedures for the methanol method and analyzed for volatile organic compounds by the EPA.

Chloromethane, acetone, chloroform, 2-butanone, benzene, toluene, ethylbenzene, and total xylenes were detected in all seven soil samples; however, these compounds were also detected at similar concentrations in both trip blanks and the presence of these compounds in the soil samples is questionable. Methylene chloride, which was detected in samples B-1 (14-15.5) and B-2 (14.5-16), was also detected in the laboratory blank, indicating probable laboratory contamination. Method detection limits ranged from 100 to 200 ug/kg.

A review of the volatile organic analytical results by BCM (contained in Appendix 4 of the draft Field Investigation Report) indicated that the only volatile organic compounds detected in the three sample sets were also found in the associated blanks. The EPA has concluded that no volatile compounds detected can be attributed to the actual soil samples; the review of BCM's analytical results supports the EPA's conclusion.

3.3.2.4 Physical/Chemical Parameter Testing

Ten soil samples were obtained and analyzed for physical/chemical parameters. Results of these analyses are presented in Table 3-9.

Comparison of analytical results for soils beneath fill material and background samples shows that soil pH ranges from 5.4 to 7.5, with the pH of the background samples ranging from 6.0 to 6.7. Total organic carbon values ranged from 167 mg/kg to 7,750 mg/kg for the soil samples and from 1,540 mg/kg to 2,190 mg/kg for background samples. Cation exchange capacity values ranged from 3.4 milli-equivalents per 100 grams (meq/g) to 7.8 meq/g and from 4.1 meq/g to 7.8 meq/g for background samples. Water content ranged from 16.4 to 26.2 percent, with 18.7 to 21.5 percent for background soils; unit dry weights ranged from 95.6 pounds per cubic foot (pcf) to 113.5 pcf, with background samples ranging from 103 pcf to 111.7 pcf. Specific gravity ranged to 2.67 to 2.79; background specific gravity ranged from 2.70 to 2.77. Coefficients of permeability ranged from 7.08 x 10^{-7} centimeters per second (cm/sec) to 2.58 x 10^{-5} cm/sec with background soils ranging from 7.93 x 10^{-7} cm/sec to 1.32 x 10^{-5} cm/sec.

3.3.3 Summary of Results

Fill material at the Site covers an area of approximately 40,000 square yards and consists of two general categories of fill: (1) cinder fill, which is composed of black cinders with broken cinder blocks, and (2) trash fill, which is composed of a mixture of construction and demolition debris and commercial and domestic trash. The cinder fill was observed in the western portion of the Site. The trash fill occupies the central and eastern portion of the Site and covers an area of approximately 28,000 square yards. The volume of trash fill is estimated to be on the order of 140,000 cubic yards (assuming an average depth of 15 feet).

3.3.3.1 Fill Material

From December 1985 to November 1987, material from the landfill was obtained for chemical analyses and included: surface soil samples (BS1 through BS10), surface water (WA-4 and WA-5) and surface sediment samples (SED-4 and SED-5), and samples of cinder fill material (TP-2 and B-3A (4-5.5). Results of samples obtained from the fill material indicate the presence of contaminants, primarily volatile and semi-volatile organic compounds. Eight volatile compounds, primarily toluene, 1,2-dichloroethane, tetrachloroethene, and trichlorofluoromethane were detected in surface soil and sediment samples from the fill material. Total volatile organic compounds (total volatiles) detected in samples from the fill material ranged from 90 ug/kg to 14,410 ug/kg. The highest concentrations of total volatiles were detected in the sediment samples (SED-4 and SED-5) from the onsite pond area at 3,150 ug/kg and 14,410 ug/kg; slightly lower total volatiles were detected along the northern edge of the landfill (BS2 and BS3) at 4,220 ug/kg and 1,270 ug/kg. Also, total volatiles (primarily toluene and trichlorofluoromethane) from the onsite ponded water (WA-4 and WA-5) were 1,225.5 ug/l and 1,095.6 ug/l.

Twenty-one semi-volatile compounds were detected in the fill material. The total detected concentrations of semi-volatile compounds ranged from 840 ug/kg in sample B-3A (4-5.5), obtained from the cinder fill, to 183,030 ug/kg in sample TP-2, also obtained from the cinder fill along the northern edge of the landfill. Total semi-volatile compounds from sample SED-4 (obtained from the onsite pond) were 153,400 ug/kg. Pesticides were detected in the sediment samples from the onsite ponded area and in sample TP-2 (cinder fill).

Volatile and semi-volatile organic compounds, the primary contaminants detected in the samples, were detected in the fill material throughout the landfill, with the highest concentrations noted in samples from the onsite ponded area located along the western side of the landfill and in Sample TP-2, located along the northern edge of the landfill. Generally, volatile and semi-volatile concentrations were lower in the eastern portion of the landfill. However, since the surface soil samples were not tested for semi-volatiles, except for a composite sample, the spatial distribution of semi-volatiles throughout the fill material is uncertain.

3.3.3.2 Natural Soil

To obtain information on the potential migration of contaminants from the fill material to the underlying natural soil, samples of natural soil were obtained from four test pits in May 1986 and from six test borings in November 1987. Samples from the test pits (TP-5, TP-10, TP-11, and TP-14) were obtained from soil just below the base of the fill material. Samples from the test borings (B-1, B-2, B-2A; and B-3) were obtained from soil just beneath the fill material, and at intermediate and deeper depths beneath the base of the fill material.

Analytical results of the soil samples indicate the presence of volatile organic compounds in the natural soil immediately beneath of the fill material from test pits TP-5, TP-10, TP-11, and TP-14. No volatiles were detected in the samples obtained from the November 1987 test borings. Seventeen semi-volatile organic compounds were detected in the natural soil obtained from borings B-1, B-2, and B-3 and test pits TP-11 and TP-14 from just below the fill material. With the exception of TP-14, total semi-volatile compounds detected in the natural soil just beneath the fill material ranged from 110 ug/kg in B-2 (14.5-16) to 2,200 ug/kg in TP-11. Total semi-volatile compounds were detected in TP-14 at 296,300 ug/kg; the maximum detected concentrations of semi-volatiles compounds were generally present in this sample.

Soil samples were obtained to obtain information on the migration of contaminants associated with the fill material through the soil from Borings B-1, B-2, B-2A, and B-3 at depths ranging from approximately 15 to 30 feet beneath the base of the fill material. With the exception of diethylphthalte, which was detected at 20 ug/kg in sample B-3 (30 to 31.5), no volatile or semi-volatile compounds were detected in these deeper samples. No pesticides or PCBs were detected in these samples.

Migration of contaminants associated with the LOU to the underlying natural soil appears to be limited to the interval immediately beneath the base of the fill material. Volatile and semi-volatile compounds, the primary contaminants identified in fill material were generally detected in natural soil immediately beneath the base of the trash fill at concentrations up to several orders of magnitude lower than detected in the fill material. However, elevated levels of volatile and semi-volatile compounds were detected beneath the fill in the central region of the landfill (TP-14). In addition, no volatile compounds, semi-volatile compounds (with the exception of diethylphthalate, which was detected as 20 ug/kg in soil obtained approximately 13 feet below the fill), or pesticides were detected in the natural soil samples obtained 15 to 30 feet beneath the base of the fill, with the exception of the semi-volatile compound diethylphthalate.

3.4 AIR MONITORING SUMMARY

3.4.1 Initial Site Investigation

Organic vapor monitoring was conducted continuously during test pit excavation in May 1986 to determine the level of respiratory protection required, and to determine whether or not high organic vapor concentrations would necessitate immediate test pit backfill and evacuation of the test pit area. Organic vapor monitoring was conducted using an HNu-Pt101 Photoionization Detector (HNu).

All monitoring was performed outside of the actual test pits, with readings taken at the top of the pit and in the workers' breathing zone. Monitor readings were not taken within test pits for safety reasons - pits may be unstable and unsafe to enter for any purpose. Breathing zone and pit edge readings were sufficient for the purposes stated above. The level of protection was downgraded from B to C for all onsite personnel except the backhoe operator. The operator remained at Level B, as a precaution, because of his proximity to the pit.

Upon completion of the backfill operation, test pits were scanned to determine if additional cover material was needed. Additional cover was not required.,

Table 3-10 lists the range of readings obtained during test pit activities and lists the corresponding levels of protection for each pit location.

3.4.2 Additional Landfill Investigation

Organic vapor monitoring was conducted continuously during test boring drilling activities in November 1987. All monitoring was performed using an HNu and results were recorded in a bound field book. A summary of air monitoring for November 1987 field activities is contained in Table 3-11. In addition, soil samples obtained during test bore drilling activities were scanned for organic vapors using an HNu. These results are contained in test boring logs (Appendix B).

Monitor readings were taken in the breathing zone and at the top of the test boring. No sustained levels of 5 parts per million (ppm) or greater above background were recorded in the breathing zone; however, HNu readings up to 14 ppm, which were not sustained, were recorded in the breathing zone during drilling at Boring B-2.

Drilling activities in fill material at Borings B-1, B-2, B-2A, B-3, and B-3A were conducted at Level of Protection "C." The level of protection was downgraded to "D" at these borings when natural soil was encountered. The background boring, B-4, was drilled using Level of Protection "D."

3.5 UNDERGROUND TANK INVESTIGATION

Four underground storage tanks are currently located onsite (Figure 1-2). A 10,000-gallon diesel fuel tank and a 4,000-gallon diesel fuel tank were installed in 1986. An 8,000-gallon diesel fuel tank was installed approximately 10 years ago. The age of an 1,000-gallon gasoline tank is unknown. Underground tank information, including dimensions, usage, and results confirming the structural integrity of the 1,000-gallon and 8,000-gallon tanks are contained in Appendix C.

The data contained in Appendix C indicate acceptable structural integrity of the underground tanks. Consequently, no sampling of these tanks was required by the EPA during this investigation (letter dated October 30, 1987, from Geraldyn Downes-Valls of EPA to Alan Robinson of BCM).

TABLE 3-10

AIR MONITORING SUMMARY
INITIAL SITE INVESTIGATION

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

TEST PIT LOCATION	CONCENTRATION RANGE* (ppm)	LEVEL OF PROTECTION
TP-1	NIR-1,000 (P) NIR-10.0 (BZ)	B
TP-2	NIR-1.0 (P) NIR-1.0 (BZ)	C
TP-3	NIR-1.0 (P) NIR-1.0 (BZ)	C
TP-4	NIR-0.8 (P) NIR-0.4 (BZ)	C
TP-5	NIR-5.2 (P) NIR-2.0 (BZ)	C
TP-6	NIR-140.0 (P) NIR-5.8 (BZ)	C
TP-7	NIR-20.0 (P) NIR-0.8 (BZ)	C
TP-8	NIR-10.0 (P) NIR-0.8 (BZ)	C
TP-9	NIR-10.0 (P) NIR-6.4 (BZ)	C
TP-10	NIR-10.0(P) NIR-8.0 (BZ)	C
TP-11	NIR-20.0 (P) NIR-7.9 (BZ)	C
TP-12	NIR-10.0 (P) NIR-7.0 (BZ)	C
TP-13	NIR-10.0 (P) NIR-0.8 (BZ)	C
TP-14	NIR-20.0 (P) NIR-6.0 (BZ)	C
TP-15	NIR-0.8 (P) NIR-0.4 (BZ)	C

* Concentration range reported at levels above background
P Pit
BZ Breathing zone
NIR No instrument response

Source: BCM Engineers (BCM Project Nos. 00-5808-01 and 00-5528-01)

TABLE 3-11

AIR MONITORING SUMMARY
NOVEMBER 1987 ADDITIONAL LANDFILL INVESTIGATION

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

BORING LOCATION	CONCENTRATION RANGE* (ppm)	LEVEL OF PROTECTION
B - 1	NIR - 4.2 (B) NIR - 2.2 (BZ)	C/D
B - 2	NIR - 1.6 (B) NIR - 14.0 (BZ)	C/D
B - 2A	NIR (B) NIR - 1.0 (BZ)	C/D
B - 3	NIR - 1.6 (B) NIR (BZ)	C/D
B - 3A	NIR (B) NIR (BZ)	C/D
B - 4	NIR (B) NIR (BZ)	D

* Concentration range reported at levels above background
B Borehole
BZ Breathing zone
NIR No instrument response

Source: BCM Engineers (BCM Project No. 00-5808-01)

4.0 FATE AND TRANSPORT EVALUATION

4.1 GENERAL

The focus of this fate and transport evaluation is to assess the potential for chemicals associated with the Henderson Road Site Landfill Operable Unit to be transported through the subsoil via infiltrating water and reach groundwater. The leachable concentrations of the study chemicals were based on existing data for water and leachate samples from the Site and estimates obtained from solid sample data using the Organic Leachate Model (OLM). The actual or estimated concentrations of chemicals in the water were then used in the Rapid Assessment Model (RAM) to predict the rate of transport of the chemicals through the unsaturated zone to the bedrock. The RAM was used at the recommendation of the EPA (letter dated November 17, 1987, from Geraldyn Downes-Valls of EPA to Alan Robinson of BCM), instead of Pesticide Root Zone Model (PRIZM) or Seasonal Soil Compartment Model (SESOIL) as listed in the November 1987 Work Plan. Difficulties encountered in the application of RAM to the Landfill Site are discussed in detail in Section 4.4.2.

The objective of the fate and transport study was to evaluate processes which may affect the migration of chemicals to the groundwater and to determine if the results of the analysis could be used as guidelines for selection of chemicals of concern or other aspects of the risk assessment.

The models (OLM and RAM) used in the assessment apply to organic chemicals, and, as such were not applicable to metals. A separate discussion of the metals is included in Section 4.6.2.

The organization of this section is as follows:

- 4.2 SITE DESCRIPTION

  A description of the history of the Landfill Site and hydrogeological factors pertinent to the fate and transport evaluation

- 4.3 STUDY CHEMICALS

  A discussion of the rationale for selecting study chemicals and the data available for the Site

- 4.4 FATE AND TRANSPORT MODELING

  A description of the process to estimate leachable concentrations of the study chemicals, the Rapid Assessment Model (RAM) used to estimate the range of times required for infiltrating chemicals to reach bedrock, and simulated incorporation of the maximum concentrations into the groundwater

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- 4.5 RESULTS

The results of each phase of the fate and transport study, a discussion of the verification of the RAM, a discussion of the fate processes which may affect the stability and transport of the chemicals of concern in groundwater, a discussion of the estimated concentrations of the chemicals of concern in groundwater beneath the Site, and a discussion of fate and transport of metals

- 4.6 RECOMMENDATIONS

A list of the recommendations based on the results of the fate and transport evaluation

4.2 SITE DESCRIPTION

depth ranging from

is site 7.6 acres?

O'Hara Sanitation Company, Inc. (O'Hara Sanitation) has operated on the Site since December 1974. Currently, operations are restricted to trash transfer activities. Fill material is present to approximately 3 to 18 feet below the surface under approximately 8.3 acres of ground. The fill is predominantly construction debris (wood, metal, and glass with some paper) and cinder fill in discrete layers. The groundwater is approximately 125 to 135 feet below the ground surface. The soil, consisting of silty clays and clayey silts, is approximately 12 to 90 feet thick beneath the fill material.

Samples were obtained of the fill materials, soil beneath the fill materials, sediment from under ponded water, standing water in two test pits, and surface ponded water. Samples were obtained between December 1985 to November 1987. The results of the analyses were presented in Section 3.0. Discuss FIT 1983 samples of sediment ponded H_2O - see FIT Report May 23, 1985

4.3 STUDY CHEMICALS

RI needs to document how study chems. were selected explain why these differ from chems. of concern

The study chemicals (Table 4-1) were selected primarily to represent a broad range of physical and chemical properties. The fate and transport study is considered preliminary to the Endangerment Assessment. Therefore, the study chemicals were selected for physical and chemical properties; however, toxicity was given some consideration. Preliminary evaluation showed that carcinogens at the Site covered a broad range of volatility, water solubility, tendency to sorb to soil carbon material (Koc), and reactivity. Toluene, a noncarcinogen, was also included, based on a comparison of reference dose and concentration. Of the noncarcinogens, toluene had the lowest reference dose relative to its concentration.

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TABLE 4-1

LIST OF STUDY CHEMICALS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Parameter
Aldrin
alpha-BHC
Benzene
Benzidine
Benzo(a)anthracene
Benzo(k)fluoranthene
Benzo(a)pyrene
Bis(2-ethylhexyl)phthalate
Bis(2-chloroethyl)ether
Carbon Tetrachloride
Chlordane
Chloroform
DDT
1,2-Dichloroethane
Dieldrin
Fluoranthene
Fluorene
Heptachlor
Hexachlorobenzene
Hexachlorobutadiene
Hexachloroethane
PCB 1248
PCB 1254
Phenanthrene
Tetrachloroethene
Toluene
Trichloroethene

Source: BCM Engineers (BCM Project No. 00-5808-01)

All analytical results contained in Section 3.0 were used to conduct the fate and transport analysis, except surface soil samples BS1 through BS10 (volatile analysis only), and sediment samples SED-1, SED-2, and SED-3. The surface soil samples were obtained in December 1985 prior to field activities at the Site in order to provide preliminary information on Site contaminants needed to establish respiratory levels of protection. For the fate and transport analysis, results of the inorganic and semi-volatile analyses for the composite sample (BS Comp), which represent an average of surface Site conditions, were used. Sediment analytical results for samples SED-1, SED-2, and SED-3, which were obtained July 18, 1986, from an intermittent stream along the eastern edge of the landfill, were not used in the fate and transport assessment. These samples may contain outside sources of contamination other than the landfill and are not representative of the 8.3-acre landfill used as a basis for the RAM assessment.

4.4 FATE AND TRANSPORT MODELING

4.4.1 Leachable Concentrations of the Study Chemicals

4.4.1.1 Chemicals Found in Water

The first step in the fate and transport analyses was to estimate leachable concentrations of the study chemicals into the water infiltrating from the Landfill. The concentrations of the study chemicals found in the standing water at the Site were considered to be the most representative of actual leachable concentrations. Analyses were conducted on samples of standing water from two test pits and ponded surface water from run-off. The highest average and maximum concentration of each source (standing surface water or standing water in test pits) was used in the assessment. Table 4-2 lists the concentrations of the study chemicals found in the water samples used in the RAM assessment. The data from different sources (e.g., standing surface water; test pit water) were not combined in order to identify the areas of greatest concern.

4.4.1.2 Chemicals Found in Soils, Fill, or Sediment

For study chemicals not found in the water samples, the Organic Leachate Model (OLM, Federal Register 51:219, pages 41087 to 41095, Final Version, November 13, 1986) was used to estimate the leachable concentrations.

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TABLE 4-2

AVERAGE CONCENTRATION OF STUDY CHEMICALS IN WATER SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Parameter	Solubility (ug/l)	Maximum Concentration (ug/l)	Average Concentration Chemical (ug/l)
Ponded Water in Test Pits			
Benzene	1,750,000	152.0	76.5
Bis(2-chloroethyl)ether	10,200,000	92.0	54.5
Bis(2-ethylhexyl)phthalate	340	24.0	15.7
Benzo(k)fluoranthene	4.3	35.0	29.0
Chloroform	8,200,000	30.2	15.6
DDT	5	3.2	3.2
Fluoranthene	206	183.0	143.5
Fluorene	1,690	16.0	10.5
Hexachlorobenzene	6	16.0	10.5
Hexachlorobutadiene	150	35.0	32.7
Hexachloroethane	50,000	23.0	14.0
Tetrachloroethene	150,000	34.9	18.0
Trichloroethene	1,500,000	14.1	7.6
Standing Surface Water			
Aldrin	180	16.0	8.1
Toluene	532.000	844.0	796.0

Source: BCM Engineers (BCM Project No. 00-5808-01)

The OLM is an empirical model from data on chemicals that were leached from landfill material. For the OLM, the maximum and average concentrations for each source (fill material, natural soil under the fill material, surface soils, or sediment under standing water) were used to estimate the concentrations that could leach into the infiltrating water. The OLM uses the following equation:

$$Co = 0.002211 \times Cw^{0.678} \times S^{0.373}$$

where:

Co = leachable concentration (mg/l)
Cw = concentration in solid sample (mg/kg)
S = solubility of chemical (mg/l)

Table 4-3 lists the study chemicals found only in solid samples, their solubilities, and the estimated leachable concentrations based on the OLM.

In order to verify the OLM model, data for water in direct contact with fill/sediment material were evaluated. Table 4-4 lists measured and OLM-predicted concentrations for chemicals found both in water and adjacent fill or sediment material. The OLM model underestimated the measured concentration by a factor of 5 (mean of 7 sets of data), with a range of 2 to 13 times lower than measured. Thus, the data suggest a conservative approach for the risk assessment would be to multiply the OLM-predicted concentration by a factor of 10.

An alternative to the OLM model is to use the solubility of the chemical (EPA, 1988). Inspection of Table 4-3 shows that use of the solubility limit instead of 10 times the OLM-predicted concentration principally affects only chemicals with a solubility greater than 100 ug/l.

To test the use of the solubility limit instead of the estimated leachable concentrations, the rate of removal for the maximum mass of a chemical available for leaching into the groundwater was calculated for the more soluble chemicals found only in solid material. Inspection of the data in Appendix D shows that if the solubility limit is used, four of these chemicals in the soils will be washed out of the landfill in less than 1 year, and two others in less than 7 years. Only one chemical, phenanthrene, can be expected to persist in the soils based on leaching at the solubility limit.

Also, inspection of Table 4-2 shows that the measured maximum concentration of many water soluble chemicals in the water is less than the solubility limit by factors of 1,000 to 1,000,000. Therefore, the OLM model, not the chemical solubility limits, were used in this assessment.

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TABLE 4-3

CONCENTRATION OF CHEMICALS FOUND ONLY IN SOLID SAMPLES,
SOLUBILITY LIMITS, AND OLM ESTIMATED LEACHABLE CONCENTRATIONS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Parameter	Concentration Maximum (ug/kg)	Concentration Average (ug/kg)	Solubility (ug/l)	OLM Estimated Concentration Maximum (ug/l)	OLM Estimated Concentration Average (ug/l)
Fill Material					
PCB-1248	8,300.0	8,300.0	54.0	3.1	3.1
PCB-1254	5,500.0	5,500.0	56.0	2.4	2.4
Natural Soil under Fill Material					
Chlordane	134.0	44.7	560.0	0.46	0.2
Sediment under Ponded Water					
alpha-BHC	14.0	9.4	1,630.0	0.15	0.1
Benzidine	7,300.0	4,150.0	400,000.0	79.5	54.2
Carbon Tetrachloride	20.0	15	757,000.0	1.8	1.5
1,2-Dichloroethane	9,110.0	4,600.0	8,690,000.0	291.3	183.2
Dieldrin	3.9	3.2	195.0	0.027	0.024
Heptachlor	19.0	10.0	180.0	0.079	0.051
Surface Soil					
Benzo(a)anthracene	6,500.0	6,500.0	5.7	1.1	1.1
Benzo(a)pyrene	5,500.0	5,500.0	1.2	0.6	0.6
Phenanthrene	14,000.0	14,000.0	1,000.0	13.2	13.2

Source: BCM Engineers (BCM Project No. 00-5808-01)

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TABLE 4-4

MEASURED AND OLM-PREDICTED WATER CONCENTRATIONS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

why not PAH?	Soil or Fill Material (mg/kg)	OLM-Predicted (ug/l)	Measured (ug/l)
Test Pit 12			
Hexachlorobenzene	69	5.8	16
Hexachlorobutadiene	56	16.7	30
Ethylbenzene	0.33	6.8	52.6
Toluene	0.13	5.8	27.3
Ponded Water and Sediment			
Benzene	0.15	10.0	2.3
Ethylbenzene	0.48	8.9	2.6
Toluene	4.65	65.3	844.0

Source: BCM Engineers (BCM Project No. 00-5808-01)

4.4.2 RAM Assessment: Time Required for Leachable Concentrations of the Study Chemicals to Reach Bedrock

The next step in the fate and transport analyses was to predict a probable rate of migration of the study chemicals. For the purposes of this assessment, the time required for the leachable concentration to reach the bedrock was estimated. The Rapid Assessment Model (RAM) (USEPA, 1983, EPA-600/8-83-030) was used in this analyses, in accordance with the request by the EPA.

4.4.2.1 Description of the RAM

The RAM model was developed to predict the rate of transport of chemicals in unsaturated and saturated porous, granular subsoils for use in an emergency response evaluation. The RAM estimates the migration rate of a contaminant through the unsaturated zone to groundwater, but does not affect the steady state of the contaminant concentration unless volatilization and degradation rates are included. A conservative approach is to assume that volatilization and degradation are negligible. The RAM was used in this evaluation to estimate the time required for the concentrations of the chemicals in the infiltrating water in a clayey-silt (limited granular) matrix to reach bedrock and not groundwater. Since the unsaturated zone at the site extends into the bedrock and the RAM model only considers rates of transport through porous media, use of the RAM in this evaluation does not account for the time required for contaminant transport through bedrock in the unsaturated zone.

The RAM is based on a soil transport equation that has been simplified with nomographs. The values used in the nomographs are factors calculated using physical and chemical parameters for the Site, and study chemicals and equations provided in the RAM documentation. For this evaluation, the distance was fixed at 20 feet, to represent a lower estimate of the distance from the bottom of the landfilled materials to the top of bedrock. The RAM is not applicable to transport of chemicals through the bedrock to groundwater.

The variables in the model include velocity of the infiltrating water, distance to bedrock (approximately 20 feet), degradation of the chemicals, dispersion of the infiltrating plume, and retardation of the chemicals by sorption or binding to soil material (Appendix E).

The model allows for chemical or biological degradation, but provides no guidance on actual chemical-specific rates. Degradation was assumed to be negligible (zero) in order to derive the most conservative estimate. Chemical degradation in the groundwater includes reactions of the chemical with water (hydrolysis) or oxygen (oxidation). Biological degradation (reactions involving soil bacteria) can occur even in deep soils in the presence or absence of oxygen. Volatilization into pore space and loss to air above the landfill is also possible.

The variability of the Site physical parameters was evaluated by calculating minimum and maximum time in years for the maximum concentration of each chemical to migrate 20 feet. The results of physical/chemical measurements are presented in Table 3-9. For the maximum and minimum time estimates, the value most appropriate for this calculation was used. The fraction of organic carbon used to calculate the minimum time to bedrock was set at zero.

	Assumptions for Estimate of Time to Bedrock	
Parameter	Minimum	Maximum
Velocity	fastest	slowest
Dispersion	ignored	maximum
Retardation	ignored	most

The velocity was calculated from saturated hydraulic conductivity measured for the site soil rather than from the volume of infiltrating water because Site-specific data are always preferable to estimated book values (EPA, 1988). The use of site-specific data also allows a realistic range of actual values for transport time.

Dispersion is the process by which dissolved substances are spread out both in the direction of flow as well as perpendicular to the flow. It is a mixing process which causes dilution of the solute and is qualitatively analogous to turbulence in surface water regimes. Dispersion is the result of two physical processes: mechanical dispersion and molecular diffusion. Under most conditions, the overall process is dominated by mechanical dispersion. Mechanical dispersion is a function of the soil material through which flow is occurring. It is related to the average velocity of the groundwater by a proportionality constant.

Estimation of a dispersion coefficient from Site physical measurements is not possible. Guidelines for parameter estimation in the RAM model recommend that dispersion be ignored in one case (minimum transport time) and, in another case, that a coefficient consistent with saturated flow (maximum transport time) be used (10 percent of the distance).

Retardation factors are calculated to include interactions between organic chemicals and soil organic matter, which can retard movement of the chemicals relative to the flow of the infiltrating water. The retardation factor is determined by the bulk density of the soil material, the soil's effective porosity, the fraction of organic matter in the soil, and the potential for the chemical to sorb to organic matter. The highest fraction of organic carbon was used to compute the

maximum time of transport. The potential for an organic chemical to bind to soil organic material is described by a coefficient (Koc). As the value for Koc increases, the tendency for the chemical to sorb to organic carbon increases.

The applicability of models using the fraction of organic carbon to predict retardation in low organic soils is controversial. Laboratory studies in which soils are mixed with organic chemicals to measure Koc have found that the predictive capabilities of the Koc model do not apply when the carbon content falls below 800 to 1,000 mg/kg. The actual level of sorption may be greater or less than predicted by Koc depending on the properties of the chemicals (Southworth and Keller, 1986). However, currently there is no way to predict retardation of organic chemicals other than by using Koc, and to disregard Koc is to assume that no retardation occurs.

There is ample evidence to suggest that many chemicals interact with the inorganic components of soils resulting in retardation. For water soluble organic chemicals (low Koc values), sorption is probably related to cation exchange capacity and may occur by a different process than for water insoluble chemicals (Southworth and Keller, 1986). However, even water insoluble chemicals (high Koc values) have been found to sorb to inorganic surfaces. Soil mobility studies with mixtures of PCBs found that PCBs were not mobilized by either distilled water or a landfill leachate mixture in several soils including sandy (quartz) material with less than 100 mg/kg carbon and had no measureable cation exchange capacity. (Cation exchange capacity is a measure of the soil's ability to adsorb certain chemicals, particularly metals.) Another study found that greater than 5 percent of the polyaromatic hydrocarbons, benzo(a)pyrene (BaP) and anthracene, remained sorbed to a glass slide after 4 days of mixing with water and that the concentrations of the chemicals in the water were well below the solubility (Henry, 1987). Studies of sorption of DDT by three clay minerals found levels of sorption comparable to soils with organic material, and the evidence suggested that this sorption was not due to cation exchange capacity (EPA, 1979).

The level of organic carbon in the ten soil samples from the Site ranged from 7,750 to 167 mg/kg with a mean value of 1,983 mg/kg. There was only one value less than 800 mg/kg. This suggests that a model based on the fraction of organic carbon in the soil is applicable. In any case, it would not be correct to assume that no retardation occurs.

The minimum and maximum estimated times represent extreme cases and depend on multiple factors occurring simultaneously. The difference between the minimum and maximum values is several orders of magnitude for many of the parameters used in the RAM assessment. Therefore, the probability is low that the minimum or maximum times represent the actual time.

When two estimates differ by several orders of magnitude, the geometric mean may be more representative of the actual times. Therefore, a geometric mean of the minimum and maximum transport times was calculated. (The more typical arithmetic mean would be controlled by the maximum time estimate, while the geometric mean corrects this bias by calculating the mean with a formula based on logarithms.)

4.4.2.2 Difficulties Encountered in Application of the RAM

When the minimum and maximum times required for the chemicals to migrate to bedrock are estimated, two of the four parameters calculated for use in the RAM nomograph were off the axis of the nomographs and one factor always equaled zero. Although the times required for the chemicals to reach groundwater were estimated, the results are considered suspect.

The principal author of the RAM, Anthony Donigian, was contacted for assistance in evaluating the validity of the RAM under these conditions. Dr. Donigian stated that he had not encountered similar situations, although he believed that BCM was using the correct assumptions. Dr. Donigian said the validity of the nomograph approach was borderline for the Landfill Unit and might give inaccurate estimates of the time required for transport of the chemicals to bedrock.

4.5 RESULTS

4.5.1 RAM Assessment

The time required for the leachable concentration of each study chemical to reach bedrock are listed in Table 4-5, in order of increasing Koc values. The rates are presented as the minimum and maximum times using the nomograph approach and the geometric mean. Koc values were taken from Super Fund Public Health Evaluation Manual (SPHEM) whenever possible or calculated based on an estimation method recommended in "Estimation Methods for Process Constants and Properties Used in Fate Assessments" (1984, EPA/600/3-84-035).

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TABLE 4-5

STUDY CHEMICALS, Koc VALUES, AND TIME TO REACH BEDROCK

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Chemical	Koc	Time to Reach Bedrock(years) Minimum	Maximum	Geometric Mean
Benzidine	11	1	27	5
Bis(2-chloroethyl)ether	14	1	29	5
1,2-Dichloroethane	14	1	29	5
Chloroform	58	1	53	7
Benzene	83	1	67	8
Carbon Tetrachloride	110	1	81	9
Trichloroethene	126	1	90	9
Toluene	300	1	184	14
Tetrachloroethene	364	1	219	15
Dieldrin	1,700	1	958	31
alpha-BHC	3,800	1	2,069	45
Hexachlorobenzene	3,900	1	2,137	46
Fluorene	7,300	1	4,110	64
Heptachlor	12,000	1	6,575	81
Phenanthrene	14,000	1	7,671	88
Hexachloroethane	20,000	1	10,959	105
Hexachlorobutadiene	29,000	1	15,890	126
Fluoranthene	38,000	1	20,820	144
Aldrin	96,000	1	>50,000	>224
Bis(2-ethylhexyl)phthalate	123,027	1	>50,000	>224
Chlordane	140,000	1	>50,000	>224
DDT	243,000	1	>50,000	>224
PCB-1254	530,000	1	>50,000	>224
PCB-1248	530,000	1	>50,000	>224
Benzo(k)fluoranthene	550,000	1	>50,000	>224
Benzo(a)pyrene	1,023,293	1	>50,000	>224
Benzo(a)anthracene	1,380,000	1	>50,000	>224

Source: BCM Engineers (BCM Project No. 00-5808-01)

There are also large differences between the minimum and maximum estimated times for different values of Koc. As Koc increases, the range between the minimum and maximum times increases. The minimum estimated time for a chemical to reach bedrock is 1 year for chemicals with no retardation, and the longest estimated time for a chemical to reach bedrock is greater than 50,000 years for chemicals with high Koc values.

4.5.2 Verification of the RAM

A step-wise approach was used to determine whether the times estimated with the RAM were linear (e.g., whether twice the time estimated for a distance of 500 centimeters [cm] equals the estimated transport time for a distance of 1,000 cm). For the maximum and minimum transport time parameters, the RAM estimated transport times were linear. However, since the nomograph parameters were off the axis in the majority of cases, this approach did not necessarily verify the RAM.

4.5.3 Fate Processes

The assumption of no loss due to biological or chemical degradation and, in particular, volatilization, means that the maximum and average concentrations represent an upper limit on final concentrations. Volatilization from soils, fill material, and the infiltrating water can be a significant mechanism for reducing concentrations of volatile chemicals, such as benzene and toluene, as has been shown with other models (pers. comm. Dominic Digulio, Tetra Tech, Inc.).

Benzidine would probably not persist in the infiltrating water, because this chemical is rapidly bound to metal complexes in clay minerals, which indicates a low mobility. The sorption to clay minerals is so rapid that the time required cannot be estimated (EPA, 1979). Evidence for this is found in the absence of this highly soluble chemical in any water sample.

The remaining chemicals are all susceptible to chemical and biological degradation to a lesser degree. Although it is not possible to state categorically the amount of time required for degradation, comparative generalizations can be made. The polyaromatic hydrocarbons (PAHs) are susceptible to biological degradation processes in the subsoil and in natural waters, in addition to photolytic degradation in surface waters. Benzene and toluene are also susceptible to biological degradation in soils and surface waters with sufficient oxygen.

Bis(2-chloroethyl)ether, hexachlorobenzene, PCBs, and 1,2-dichloroethane are considered to be fairly persistent chemicals. There is little information on bis(2-chloroethyl)ether; however, both hydrolysis and biological degradation are known to occur. Hexachlorobenzene is probably the most persistent chemical associated with the Landfill Unit. The chemical 1,2-dichloroethane is considered to be fairly persistent, but will be affected by volatilization. Although both chemicals are susceptible to various degradation processes, the rates of degradation may be very slow.

4.5.4 Concentrations in Groundwater Under the Site

The RAM estimates the time required for the chemical to be transported to bedrock, but does not affect the maximum concentration unless degradation or volatilization is considered. To derive the most conservative estimate, degradation and volatilization were considered to be negligible. It is unlikely that the estimated leachable concentrations of the chemicals associated with the Landfill Unit represent the concentrations in groundwater under the Site since many of the soluble chemicals are also volatile. Volatilization of chemicals during transport may play an important role in reducing concentrations in the groundwater.

4.5.5 Fate and Transport of Metals

Table 4-6 summarizes the concentrations in the fill material, standing water, natural soil beneath the fill, and background samples for the metals found at the Site. The data on the natural soil and background samples are presented as mean values and standard deviations. The standard deviation is an estimate of the variability of the measurement.

Arsenic, beryllium, and cadmium concentrations in the fill material and soil beneath the fill were detected at levels less than or similar to background concentrations. Nickel and copper are slightly elevated in the fill material, but the high standard deviation around the mean for the background samples suggests the higher level in the fill material may not be significantly different.

Mercury and chromium are elevated in the fill material as compared to the background concentrations. The concentrations of both metals in the natural soil beneath the fill indicate that neither has migrated from the fill material to any extent. This is consistent with the general finding that mercury is not considered to be mobile in infiltrating water.

The mobility of chromium is controlled by valence state. The trivalent state, the dominant form in most natural systems, is not mobile and tends to have sorption and precipitation interactions with oxides and hydroxides. The hexavalent state is fairly mobile. The analytical procedures for priority pollutant metals do not distinguish between the two states. However, the absence of elevated levels of chromium in the standing water from the test pits suggests that the trivalent form is dominant since elevated chromium concentrations were detected in the fill material. Therefore, the chromium found in the fill material is unlikely to migrate into the soils beneath.

TABLE 4-6

CONCENTRATION OF STUDY METALS IN FILL, WATER,
SOIL UNDER FILL, AND BACKGROUND

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Parameters	Fill Material (mg/kg)	Maximum In Water (mg/l)	Soil Under Fill (mg/kg) Mean +/- Std. Dev.	Background (mg/kg) Mean +/- Std. Dev.
Arsenic	0.12	0.004	7.3 +/- 5.4	7.6 +/- 3.5
Beryllium	4.75	ND	4.3 +/- 3.2	2.2 +/- 1.4
Cadmium	1.65	ND	6.5 +/- 4.4	5.9 +/- 0.8
Chromium	198.00	0.003	13.7 +/- 8.6	22.7 +/- 18.9
Copper	106.00	0.03	33.8 +/- 19.9	44.0 +/- 30.0
Mercury	0.30	ND	0.24 +/- 0.28	0.12
Nickel	92.50	ND	33.0 +/- 24.5	30.5 +/- 20.5
Lead	72.00	0.027	19.7 +/- 14.7	13.0 +/- 4.2

Source: BCM Engineers (BCM Project No. 00-5808-01)

BCM

4.6 RECOMMENDATIONS

Recommendations based on the fate and transport evaluation include:

1. A Koc value of 10,000 should be used as a guideline for selection of chemicals of concern for groundwater contamination.

   Chemicals with Koc values greater than 10,000 have a maximum transport to groundwater time of 5,500 years and a geometric mean of 75 years. Given the conservative nature of the parameters used in RAM, it is highly unlikely these chemicals will pose a threat to groundwater.

2. For chemicals of concern which are found only in soils, fill, or sediment material, and are considered in the risk assessment for groundwater contamination, the concentration predicted by the OLM model should be multiplied by a factor of 10.

3. For volatile chemicals infiltrating the subsurface material, volatilization may be an important removal mechanism.

volatile to recommendation?

BCM

5.0 SUMMARY OF DATA QUALITY OBJECTIVES REVIEW

5.1 GENERAL

A review of the data quality objective (DQO) development and documentation process for the Landfill Operable Unit is summarized in the following sections. The DQO review was generally performed in accordance with the procedures contained in Data Quality Objectives for Remedial Response Activities (Development Process) (USEPA, 1987).

Data quality objectives are established during project scoping and development of sampling plans to ensure that the data collected are sufficient and of adequate quality for their intended uses. DQOs were not formally developed and outlined as described in the 1987 guidance documents during the initial project planning for the Henderson Road Site, but the November 1985 Project Operations Plan and the November 1987 ~~Work Plan/Project Operations Plan~~ Sampling Plan for the Landfill Operable Unit comply with the intent of the DQO process. The following sections contain a summary of the DQO process as applied to the Landfill Operable Unit.

Coring Activities

DQOs are developed using a three-stage process:

Stage 1 - Identify decision types
Stage 2 - Identify data uses and needs
Stage 3 - Design data collection program

DQOs should be developed at the start of a project and revised or expanded as needed throughout the project. Since DQOs were not formally developed at the onset of the Henderson Road Site RI/FS, the review of DQOs for the Landfill Operable Unit does not necessarily follow the format outlined in the guidance documents.

are needed to be presented in L.F. RI + FS similar to what we had in inj. well FS, pgs 67+68

5.2 DQO STAGE 1 - IDENTIFY DECISION TYPES

The major components of the DQO Stage 1 include:

- Identifying and involving data users
- Evaluating available data
- Developing conceptual model
- Specifying objectives/decisions

general objectives
specific objectives

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5.2.1 Data Users

The primary data users involved with the Landfill Operable Unit include the EPA project manager and the PRP's contractor, BCM.

5.2.2 Evaluate Available Data

Evaluation of available data includes preparing a description of the current situation, a review of existing data, and an assessment of the adequacy of the data. A description of the current situation, particularly the results of the completed investigations and the fate and transport analyses, are provided in Sections 3.0 and and 4.0. A summary of analytical results for surface soil, surface water, surface sediment, test pit, and test boring samples are presented in Tables 3-1 through 3-9 of the draft Landfill Investigation Report and also provided herein.

Not complete as indicate on pg 5.

Surface soil, surface water, surface sediment, and test pit samples obtained during the initial site investigation were analyzed in accordance with the EPA-approved November 11, 1985, Project Operations Plan (POP) for the Henderson Road Site. A review of these samples by the EPA indicated that all applicable QA/QC standards were met and that the data are acceptable. Samples obtained from test borings during the additional landfill investigation were analyzed in accordance with the EPA-approved November 1987 Work Plan for the Landfill Operable Unit. The chemical analyses, with the exception of seven split samples analyzed by BCM, were performed and validated by the EPA Region III Central Regional laboratory or an EPA subcontracted laboratory.

RI should explain why methods were appropriate in light of DQOs, why locations or numbers of samples were appropriate (or not), data gaps, etc. See notes on Table 5-1.

To assess the adequacy of the data, a data quality summary for samples obtained during the RI was compiled and is presented in Table 5-1. The summary includes a listing of the types of sampling performed, the objectives of the sampling, data use(s), and analyses performed.

5.2.3 Develop Conceptual Model

Using available information, a conceptual model to provide an understanding of contaminant sources, contaminant migration pathways, and potential receptors is developed. This evaluation is provided in Section 5.3.

5.2.4 Specify RI/FS Objectives

RI

General

The ~~specific RI/FS~~ objectives for the Landfill Operable Unit include:

- Determine the nature and extent of soil contamination and the potential for contamination migration to groundwater

TABLE 5-1

DATA SUMMARY TABLE
HENDERSON ROAD SITE
UPPER MERION, PENNSYLVANIA

Activity	Surface Soil	Surface Water	Surface Sediment	Test Pit	Test Boring
Objective	10 surface soil samples were obtained from various onsite locations	2 samples obtained from onsite ponded water to aid in assessing site impact on surrounding areas and potential for surface water migration of contaminants. Note: 3 stream sediment samples (upgradient and downgradient) were not obtained since the stream bed was dry.	2 samples obtained from onsite pond and 3 samples from onsite intermittent stream	7 samples (5 solid and 2 leachate) from soil beneath landfill to characterize wastes in landfill and extent of contamination from landfill	11 soil samples for chemical analyses and 10 soil samples for physical properties to characterize soil beneath landfill, and assess the potential for contaminants to migrate through the soil to groundwater
Prioritized Data Use(s)	Site Characterization	Site Characterization Air quality characterization Fate and Transport	Site Characterization	Site Characterization Fate and Transport Risk Assessment	Site Characterization Fate and Transport Risk Assessment
Analytical Levels	III	IV	IV	IV	II, IV
Analyses	PP VOCs, metals	PP Organics, metals	PP Organics, metals	PP Organics, metals	TCL Organics, inorganics, physical/chemical parameters

* See Data Quality Objectives for Remedial Response Activities (Development Process), USEPA, 1987 for explanation of analytical levels.

Source: BCM Engineers Inc. (BCM Project No. 00-5808-01)

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- Determine human and environmental risk from contact with contaminants (inhalation of vapor and particulates in air, ingestion of soil/fill material, ingestion of groundwater, and offsite migration of contaminated materials)

- Determine and evaluate feasible remedial alternatives

A discussion of the data requirements to achieve these objectives, specifically the quality and sufficiency of the data, is presented in Section 5.3.

5.3 CONCEPTUAL MODEL AND EVALUATION OF DATA SUFFICIENCY

5.3.1 General

The data collection component of the RI/FS process is for three purposes. The first is to establish the nature and extent of Site contamination. The second is to obtain information necessary for the endangerment assessment component of the RI, which assesses the potential impact of the Site on human health and the environment. The third purpose for this data collection is to obtain the information that will be necessary in the Feasibility Study for the screening ~~and selection~~ of potential remedial technologies and development and evaluation of remedial alternatives. Consequently, the quality and sufficiency of the data collected to date is addressed and evaluated in these three contexts.

5.3.2 Information Required for the Remedial Investigation

The investigatory programs have shown the trash fill at the Henderson Road Site to be a heterogeneous accumulation of trash materials. The trash fill consists of wood, metal, tires, plastic, paper, and cloth. The dimensions of the trash fill have been established and the volume of trash has been calculated. Samples were collected and analyzed of the cinders underlying the trash, natural soil material, retention pond sediment, retention pond water, and water/leachate within the trash fill. Although 50 priority pollutant chemicals were detected in one or more of these samples, no accumulations of industrial chemical waste were observed in the surface inspection, test pits, or borings. Two of the November 1987 borings (B-2 and B-2A) were located where there was suspicion that liquid waste had been disposed. No such accumulations were observed. The presence of a wide range of priority pollutant and inorganic ions and organic chemicals is not unusual in a mixed nonindustrial waste fill.

The November 1987 additional landfill investigation program was designed in part to assess the deeper overburden zone above bedrock beneath the landfill to evaluate the potential for groundwater contamination originating from the trash fill. The concentrations of metals detected in the November 1987 investigation were not elevated in comparison to background levels. Concentrations of organic chemicals were not detected at substantial concentrations in any of the November 1987 samples. It is recognized that the November 1987 program obtained results at only three locations (plus a background location) within the approximately 5.5-acre trash fill. However, these borings were completed at locations where elevated organic vapor readings (by OVA) had been previously recorded (Boring B-1), that were suspected of having been areas where non-trash wastes had been disposed (Boring B-2 and B-2A), or in the case of Boring No. 3, was positioned at a location of internal runoff drainage, where elevated concentrations of several organic compounds were found in the shallow sediment samples, and where contaminant migration might be preferentially located. Consequently, the November 1987 sampling program should be considered biased in terms of having been developed and implemented to obtain information in areas most likely to have contamination.

Regional groundwater quality and groundwater contamination associated with the Injection Well Operable Unit, the nearby Kessler Site, and possibly other sites unrelated to these two sites have been established in the area (BCM, 1988). Groundwater quality associated with the Landfill Operable Unit has not been established. No groundwater monitoring wells were installed for the landfill investigation; none of the monitoring wells installed for the Injection Well Operable Unit remedial investigation were placed downgradient from the landfill. However, the Philadelphia Suburban Water Company's (PSWC) "O'Hara" monitoring well which monitors a relatively shallow groundwater zone is located approximately 200 feet downgradient of the landfill. Discuss limitations of reliance on this one well in more detail in RI -- fracture flow -- lateral/vertical representativeness -- prospects that gw beneath LF flow east of well

The PSWC "O'Hara" monitoring well was sampled and analyzed as part of the Injection Well Operable Unit Investigation. Concentrations of only three organic compounds were detected: toluene (23.04 ug/l), trichloroethene (1.1 ug/l), and tetrachloroethene (1.1 ug/l). Analytical data which are presented and discussed in the IWO4 RI are included as Appendix F. The concentrations detected in this well are relatively low both in comparison to well samples closer to the Injection Well and the regional groundwater quality. Unfortunately, the groundwater zone influencing groundwater quality in this monitoring well is unknown. Consequently, it is unclear whether the relatively high groundwater quality (in comparison to groundwater monitored closer to the Injection Well) indicates minimal influence of the landfill on local groundwater or not.

Crooked Lane well should be discussed in RI

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A fate and transport evaluation was conducted as part of the additional landfill investigation program to assess the potential fate of contaminants detected in the landfill portion of the Site. Using the most conservative assumptions (that the compounds will not degrade over time), travel time to the soil/bedrock interface were calculated and are provided in Table 4-5. While use of the RAM model has resulted in the calculation of contaminant concentrations reaching bedrock and by inference groundwater, this is not necessarily true. The model's assumption that the contaminants are conservative (will not decrease in concentration due to volatilization, adsorption, dilution, and/or other factors) is incorrect. Consequently, the RAM model does not provide a valid scientific basis for conclusions to base the assessment of risk to the groundwater or users thereof.

5.3.3 Information Required for the Endangerment Assessment

aquatic life impact from surface drainage

The risks to human health and the environment posed by the Landfill Operable Unit are a function of potential exposure routes. Potential exposure routes for the landfill material include migration to groundwater and ultimate ingestion by human beings or other animals, dermal contact, and inhalation of wind-blown dust or vapors. The primary purpose of the Additional Landfill Investigation Program was to obtain chemical and physical characteristics of Site subsoils to establish whether contaminants had migrated from the landfilled material to a greater depth and thus might pose a threat to groundwater. As was described in Section 3.0, contaminants which had been found in surface soil sediments and fill material were not detected at depth. However, fate and transport modeling indicated the potential for contaminant migration to groundwater. The nature and extent of groundwater contamination associated with the Landfill Operable Unit is uncertain due to the lack of groundwater analytical data to confirm the results predicted in the fate and transport assessment. Consequently, additional information on groundwater quality beneath or downgradient from the landfill is required to complete the endangerment assessment. Section 3.0 of this document summarizes the original October 1986 draft RI report and describes in detail data on the chemical characteristics of the fill material and natural soil beneath the fill material. These data will be used to evaluate risks of dermal exposure.

Inhalation is the third potential exposure route. During the course of the implementation of a capping or excavation remediation, the landfill material will be disturbed. There is potential for the creation of wind-blown dust. Although there are management techniques to minimize this exposure, primarily the wetting of materials so as to dampen them and inhibit dust creation, there still remains the potential for dust creation and inhalation exposure. Exposure/dispersion models described in EPA documents (see Endangerment Assessment Work Plan) will be used with existing data to evaluate this exposure rate.

Discuss present operations i.e. dust problem from trucks
" future " - closure of L.F., move operations to other side of Turnpike

BCM

Discuss ... W.O. ... See ... Order. Explain why ... RI. ... (because construction debris ... asbestos was 1st considered to be ... could very well include asbestos) + why it was not analyzed in the RI. Sampling

During preparation of the November 1987 Work Plan, the EPA had requested asbestos sampling so that the endangerment assessment could evaluate exposure to asbestos. When, Linda Henry of BCM contacted Mike Giuranna (EPA, Environmental Services) on July 17, 1988, for guidance with regard to asbestos sampling, he indicated that since there is no known asbestos source at the Site that sampling would be impractical. He would not recommend asbestos sampling. However, he did suggest that during any remedial activities, fill material be visually monitored and that standard dust suppression techniques be utilized.

In summary, with the exception of groundwater quality data, the investigatory work that has been completed, together with the information on the Site and environs characterized in the Injection Well RI and endangerment assessment, is sufficient to conduct the endangerment assessment for the Landfill Operable Unit.

5.3.4 Information Required for Evaluation of Remedial Alternatives

The general remedial alternatives which will be considered for the Feasibility Study include no-action, capping, and excavation with offsite disposal, or a combination of these. Fixation in place or onsite incineration are not practical due to the heterogeneous nature of the materials and other considerations. Data sufficiency is, therefore, evaluated in the context of the possible remedial alternatives.

will require screening in FS. Can't conclude is in FS workplan!

Information necessary to evaluate the capping alternative includes the dimensions and volume of fill material, the chemical characteristics of the fill material, and environmental considerations including potential impacts to groundwater and inhalation exposure during grading. The limits of the trash fill have been delineated and are shown in Figure 3-1. The fill volume has been calculated. A discussion of the extent, distribution, and content of the fill material is contained in Section 3.3.3. Environmental considerations were discussed in the previous section. Consequently, sufficient information has been collected to evaluate this remedial alternative.

Information needed to evaluate the excavation alternative includes the nature and volume of the material, post-excavation grading requirements, and characterization for offsite disposal. The fill volume has been estimated and post-excavation grading requirements can be evaluated with existing data. Sufficient chemical data are available to characterize the waste material for offsite disposal evaluation. The potential environmental concern for this alternative is inhalation exposure which has been previously discussed.

Need to determine whether material is RCRA hazardous. ARAR implications.

Offsite disposal approaches include recycling of certain materials, landfilling, and possibly incineration. The landfill will be evaluated as part of the FS to estimate the volume of material which may possibly be recyclable. The fill materials at the Site are consistent with typical commercial wastes that are traditionally recycled or landfilled. The feasibility and costs associated with landfilling and incineration can be evaluated based on these characteristics.

?

Discuss pot. need for Phase 2 RI - see Compliance Schedule; treatability investigations. At conclusion of Ph 2 FS will propose whether wells are needed as RI Phase 2. See Item M in Compliance Sched.

wp should have described how. What data is needed? Will this be part of Phase I, II or III of FS? Is not discussed in FS wp.

6.0 REMEDIAL INVESTIGATION SCOPE OF WORK

This section identifies the tasks that will be implemented during the performance of the remainder of the remedial investigation portion of the Remedial Investigation/Feasibility Study (RI/FS) for the Landfill Operable Unit of the Henderson Road Site.

6.1 GROUNDWATER INVESTIGATION

- Delete all of section 6.1. Is not part of L.F. workplan. See transmittal letter.

6.1.1 General

The groundwater investigation is structured to fill the data gaps that exist for the LOU, specifically groundwater quality data to confirm the results predicted in the fate and transport assessment. The need for groundwater quality data was discussed in Section 5.3.

6.1.2 Investigation Methodology

Is not a map. Locations have not been finalized. Pumping well ... will not represent gw qual affected by ... This is a fracture-flow system

Six groundwater monitoring wells will be installed onsite to obtain information on groundwater quality associated with the LOU. The six monitoring wells will be installed as two well triplets at two locations. One triplet will be located hydraulically upgradient of the landfill to determine background water quality; one triplet will be located hydraulically downgradient to supply information for groundwater quality associated with the LOU (Figure 6-1). Installation of these wells has been proposed as part of the remediation program to be implemented for the Henderson Road Site IWOU. Methodology for the installation of these wells is presented in the following paragraphs and is summarized from the August 23, 1988, draft Remedial Design/Remedial Action Statement of Work for the IWOU. These wells will be sampled and analyzed for EPA target compound list inorganic and organic constituents. Following data validation, the results will be reviewed within the overall context of area groundwater, including contamination associated with the Injection Well Operable Unit, the Kessler Site, and the LOU. A recommendation will be made, based on this review, of whether additional groundwater data are necessary and within which context.

was not approved by EPA, is not incorporated into this workplan

The downgradient cluster will consist of three wells, placed at depths between 150 and 400 feet below grade, and located east of the former injection well (further east than the HR-4 cluster). The downgradient monitoring well cluster will be installed to similar depths between the Site and the UMR and will be used to evaluate the groundwater quality in this area. The upgradient monitoring well cluster will be installed to depths of 150, 225, and 350 feet and will be used to evaluate groundwater

quality entering the site. Should substantial site-related contaminants be detected in the deeper monitoring wells, the wells will be deepened to 500 feet or an additional, deeper monitoring well will be added to two onsite monitoring well clusters. The EPA will approve the final location of all new monitoring wells.

The wells will be drilled by advancing an 8-3/4-diameter borehole down through the unconsolidated sediment (overburden) to the fractured bedrock surface to allow the installation of a temporary 8-inch diameter steel casing to prevent the overburden from caving in. Either a 4-inch open hole or 4-inch cased well will be installed. The determining factor in selecting an open-hole versus a cased well will be the stability of the formation. Should the bedrock be stable enough to remain an open hole, the 4-inch casing will be set 10 feet into the competent rock and grouted in place as the 8-inch temporary casing is removed. If the bedrock is not stable enough to allow an open hole monitoring well, the casing and screen materials will be required. Sufficient screen will be required to submerge a 10- to 15-foot section into the water table. Following development of the wells, and a 2-week period to allow conditions surrounding the well to equilibrate, the wells will be checked for floating product.

6.1.3 Analytical Parameters and Procedures

Subsequent to installation of the six monitoring wells, the wells will be sampled in accordance with procedures contained in the November 1985 POP for the parameters included in Table 6-1. Analytical results from these analyses will be presented in the LOU RI report.

Additionally, these wells will be sampled in accordance with the IWOU sampling and analysis program currently being drafted.

6.2 ENDANGERMENT ASSESSMENT

This work plan outlines the sections of the Endangerment Assessment (EA) which require site-specific decisions. The details of the proposed procedures for the identification of chemicals of concern, selection of exposure concentrations and models, and approach for the environmental assessment are included. The endangerment assessment will be conducted in accordance with the Endangerment Assessment Handbook (Draft) (PRC, 1985), the Superfund Public Health Evaluation Manual (EPA, 1986), using exposure models from the Superfund Exposure Assessment Manual (EPA, 1988), the Compilation of Air Pollutant Emission Factors (AP-42, 1985), and other relevant documents.

Inadequate detail on air modeling.
Meeting to be held on Oct. 24 with BCM and EPA to discuss air modelling.

BCM

TABLE 6-1

MONITORING WELL SAMPLING AND ANALYSIS PROGRAM

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Parameter	Procedure	Reference
Volatiles	GC/MS CLP-SOW	1
Semi-volatiles	GC/MS CLP-SOW	1
Conventional Parameter*	ICP-6010	2
	Zinc	2

* Parameters include BOD_5, COD, ammonia-N, phosphates, pH, TSS, TDS, oil and grease, alkalinity, and hardness.

Reference:

(1) Current USEPA Contract Laboratory Program Statement of Work (CLP-SOW) for Analysis of Multi-media, Multi-concentration Organics.

(2) USEPA, EMSL-ORD, "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, Revised March, 1983.

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6.2.1 Hazard Identification

Include 1988 FIT data, summarized in 5/23/85 FIT report.

6.2.1.1 Compilation of Data

The data collected during the remedial investigation will be compiled into water and soil/fill groups for the risk assessment. The data for concentrations in the water will include standing water from the test pits (TP-12 and TP-14) surface standing water (samples WA-4, WA-5, and WA-4-5) ~~and data from the proposed monitoring wells~~. The data for concentrations in the soil/fill material will include the fill material sample (TP-12), the surface soil samples (BS COMP and BS1 through BS10), and the sediment under the surface water (samples SED-4 and SED-5).

Certain criteria will be implemented when calculating geometric means for average concentrations. When a concentration is reported as less than the detection limit, one-half of the sample detection limit for each chemical will be used in calculating the mean, with one exception. This exception occurs when the sample detection limit for a specific chemical is elevated above reported concentrations for the same chemical in other samples of that medium. In such cases, the use of one-half of this high detection limit would bias the mean, particularly when several samples have significantly elevated detection limits. Therefore, samples with detection limits elevated above maximum detected concentrations will be considered on a case-by-case basis.

Samples taken from natural soil under the fill will be considered separately. The natural soil under the fill may contain chemicals from the landfill; however, to include this data in the calculation of average concentrations in the landfill material may result in a lower number than is representative of fill material. The concentrations obtained for volatile organic analysis from below the fill material in November 1987 will not be included in the risk assessment because the chemicals detected in site samples were found at similar levels in the trip blanks.

6.2.1.2 Identification of Chemicals of Concern

The indicator score method, in accordance with SPHEM, 1986, will be followed to identify indicator chemicals for the public health evaluation. The focus of the screening process is public health evaluation, including the potential for bioconcentration and food chain transfer. The chemicals of concern for aquatic and other wildlife are discussed in the Environmental Risk Assessment (Section 6.1.7).

There are several steps involved in the screening process to determine the chemicals likely to pose the most significant risk to exposure via soil material, chemical vapors, ground and surface water contamination, and offsite migration of dissolved and particulate chemicals to the adjacent intermittent stream. First, the data for all chemicals found in the water and soil/fill/sediment material will be compiled with the range and maximum concentrations, and frequency of detection. Since Site operations could result in exposure to deeper soils as well as surficial material, the maximum values found in any Site area will be considered.

metals were not tested for WA, were they?

The concentrations of metals will be compared to those found in the background samples. Metals detected onsite at concentrations below natural background levels can be eliminated during this step. Appropriate statistical analysis to compare onsite levels with background samples will be used.

Next, indicator score (IS) values will be calculated from the maximum concentrations and the toxicity constant for the appropriate media (water or soils) listed in SPHEM. IS values for carcinogens and non-carcinogens will be done separately. This information will be listed along with the toxicity ranking values for carcinogens and non-carcinogens, soil sorption (Koc), volatility, and solubility values for chemicals found in soils and in water. Chemicals without sufficient information to calculate IS values will also be included.

The final selection process will be based on the following general and media-specific guidelines:

- IS and Toxicity Ranking

  The highest ranking chemicals will be considered first. All Category A and B1 carcinogens will be included during this step.

- Frequency of Detection

  Chemicals which were detected in several samples will be given greater weight than those which were only detected once. The number of times the chemical was included in the analysis and detection limits will also be considered.

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- Relative Proportion of Carcinogens Versus Non-Carcinogens

If the list of indicator chemicals is predominantly carcinogens, then the final list will reflect a similar proportion.

- Soils

The principal routes of exposure for chemicals in soils are for soil material (direct ingestion and fugitive dusts), chemical vapors, offsite migration of soil material, and contamination of the groundwater. Chemicals with high potential for volatilization will be selected to address exposure to chemical vapors. Chemicals with high potential for persistence and sorption to soil material will be selected to represent exposure to soil material and also to consider the potential for offsite migration into the intermittent stream for bioconcentration and food chain transfer. The solubility will be considered for chemicals with high IS values to determine the potential for groundwater contamination.

- Water

The indicator chemicalsfor ingestion of groundwater will be selected based on IS values. Koc values less than 10,000 and a comparison of the analyses in the upgradient with downgradient wells. Chemicals found only in downgradient wells or a higher concentrations in downgradient wells will be considered. The fate and transport evaluation found that chemicals with Koc values greater than 10,000 are unlikely to migrate appreciable distances.

Supplement with discussion of concept of aquifer restoration

This evaluation will be made despite the circumstances that make the consumption of groundwater from immediately downgradient of the landfill unrealistic. These circumstances are that there are no water supply wells between the landfill and the UMR. The land is owned by O'Hara Sanitation and PSWC. O'Hara Sanitation facilities are on public water. The PSWC pumps water from the UMR. Also, institutional controls will be implemented as part of the Injection Well Unit RD/RA. The Henderson Road area is served by public water. There are two or more major groundwater contamination problems in the immediate area. Consequently, the use of this groundwater for water supply is highly unlikely.

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- Offsite Sediments

  Three sediment samples were taken from an intermittent stream offsite at the western boundary of the landfill. Inspection of the data on Table 3-1 shows that none of the chemicals found in the two samples (SED-2 and SED-3) hydraulically linked with the Site were detected at elevated levels compared to levels found in the sample upgradient (SED-1) of the Site. Therefore, given the variability in the reported concentrations, these chemicals are considered to be ubiquitous in the intermittent stream-bed and not Site-related.

6.2.1.3 Asbestos

Incorporation of asbestos into the risk assessment and communication with EPA personnel knowledgeable in fugitive dust emissions were recommended by the EPA in previous communications regarding the landfill. The EPA air emissions specialist, Mike Giuranna, confirmed the recommendations of a BCM asbestos specialist that there is no suitable method for estimating the release of asbestos from a landfill or amount of asbestos contained in the landfill. The alternative of air monitoring of fugitive dust emissions for asbestos was also considered an inadequate approach by both the EPA and BCM specialists because of the difficulty in determining the source of any asbestos in the air samples.

6.2.2 Exposure Assessment

6.2.2.1 Exposure Pathways

The following exposure pathways were considered to represent the maximum potential for exposure by human beings. The exposure pathways used to assess environmental risk are discussed in Section 6.1.7.

- Inhalation of Fugitive Dust and Vapor Emissions

  The trash transferral activities at the Site result in releases of particulates and vapors to the air. These emissions could result in exposure by workers at the Site as well as area residents.

- Ingestion of Landfill Material

Workers at the Site may ingest soil or particulate landfill material during work activities and are considered the primary ~~exposed~~ population. The duration of exposure for area residents trespassing on the Site would be considerably lower than that for workers.

potentially exposed via ingestion.

- Ingestion of Groundwater

The risk associated with ingestion of the groundwater beneath the landfill will be considered.

and areas of buried tanks.

6.2.2.2 Concentrations at the Point of Exposure

- Fugitive Dusts and Vapors

The maximum and average concentration of each chemical of concern at the point of exposure will be estimated by combining emission rates with an atmospheric dispersion model (Falco and Schaum, 1984). The maximum and average concentrations of the chemicals of concern found in all Site soils and sediment samples will be used.

The emission rate for particulates will be calculated using the model in the Compilation of Air Pollutant Emission Factors (AP-42, 1985) for emissions due to aggregate handling and storage of materials and will be the sum of emissions due to:

1. Vehicular traffic on unpaved roads
2. Batch drop operations
3. Wind erosion

Site-specific information will be used for silt content, mean vehicle speed, mean vehicle weight, and drop height. Regional information will be used for wind speed and the precipitation factor.

The emission rate for ~~volatiles~~ will be estimated with a model for landfills (EPA, 1988). The Site data for soil porosity will be used, and the assumption of minimal effective cover will be made.

ref.

The Industrial Source Complex (ISC) Dispersion model will be used to estimate the concentration of fugitive dust and vapors at various points (EPA, 1979). Wherever possible, Site-specific information will be used for the computer model parameters.

Concentrations of the chemicals of concern will be calculated for both workers in the immediate vicinity of the source and at distances representative of the nearest actual or potential residences.

- Ingestion of Landfill Material

The maximum and average concentrations found in Site soil, fill, or sediment samples will be used to assess the risk to workers at the Site.

- Ingestion of Groundwater

The estimated potential maximum and average concentrations for the chemicals of concern in the water will be used to assess the risk associated with groundwater under the Site. If any chemicals of concern are detected only in soils, 10 times the value predicted by the OLM model will be used to estimate the concentration in the water (Section 4.4.1.2).

6.2.3 Toxicity Assessment

The toxicity assessment will present Acceptable Daily Intakes (ADI) for non-carcinogens or Potency Factor (PF) values for carcinogens and a toxicity profile for each chemical of concern. The most current ADI and PF values available will be used. For chemicals without ADI values, the methods used in the Henderson Road Site Injection Well Remedial Investigation Report will be applied.

6.2.4 Risk Characterization

6.2.4.1 Estimation of Chemical Intakes

The estimation of the chemical intake for non-carcinogens will be calculated using maximum and average daily rates, while the intake level for carcinogens will be corrected for the duration of exposure during a 70-year lifetime.

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what about ingest —?

Workers at the Site

The risk for workers at the Site will be based on the chronic daily intake via inhalation of fugitive dust and vapors and ingestion of soil or fill material. For non-carcinogens, it will be assumed that at the point of highest concentration a worker weighing 70 kg inhales 20 cubic meters of air and ingests 100 mg of fill or soil material daily. For carcinogens, the intake will be adjusted to a lifetime intake level assuming exposure for 8 hours a day, 5 days a week, for 30 years of a 70-year lifetime.

Area Residents

The intake levels for area residents will be based on inhalation alone for fugitive dust and vapors at the concentrations estimated for the appropriate distance from the Site. For both non-carcinogens and carcinogens, it will be assumed that a 70 kg adult inhales 20 cubic meters of air daily for a 70-year lifetime.

Residents Ingesting Groundwater

The intake levels for the groundwater exposure models will be based on a 70 kg adult ingesting 2 liters of water daily for a 70-year lifetime.

which wells will be used? Please identify in supplement to workplan ASAP.

6.2.4.2 Risk Quantitation

The risk will be quantitatively estimated for each exposure pathway using the methods described in SPHEM. An analysis of uncertainty will also be included.

6.2.5 Environmental Risk Assessment

6.2.5.1 Ecology of the Site

The presence of threatened or endangered species or communities and a description of the ecology of the Site and offsite area adjacent to the intermittent stream will be determined from a survey of the Site and a summary of information from State and Federal agencies (included as Section 7.6 in the RI report for the Injection Well Operable Unit).

was not in RI for inj. well

Still need a regional watershed map.

6.2.5.2 Exposure and Environmental Assessment

Exposure Assessment

Preliminary evaluation suggests that the potential for surface run-off of dissolved or particulate contaminants or release of subsurface water into the intermittent stream may be negligible. The exposure assessment will determine the potential for migration via either pathway with maps of Site drainage and regional watersheds in conjunction with a model for surface run-off (EPA, 1988) and hydrogeological evaluation.

no ref.

what does this mean? WP should describe approach.

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Environmental Assessment

The potential for impact for the chemicals of environmental concern will be assessed in accordance with the guidelines in the User's Manual for Ecological Risk Assessment (Barnthouse, 1986).

The maximum and average concentrations of the environmental chemicals in the standing and surface water samples from the Site will be compared to federal ambient water quality criteria to determine the environmental chemicals of concern. These concentrations will be used to model the impact of any water which leaves the Site via surface run-off or subsurface leaching. The impact will be assessed with the quotient method (Barnthouse, 1986).

The impact on other wildlife will also be assessed by comparison of exposed levels to toxicity values (Barnthouse, 1986). The potential for bioconcentration and transfer through the food chain will also be addressed, using the appropriate chemicals of concern from the public health evaluation.

6.3 REMEDIAL INVESTIGATION REPORT

This task encompasses the preparation of the draft and final versions of the RI report. The proposed table of contents for the RI report is presented as Figure 6-1. A substantial portion of the information to be included in the RI report has been previously described in earlier reports. Much of the report Sections 1.0 (Background Information) and 2.0 (Site and Area Features) will be taken directly from the June 1988 Injection Well Operable Unit Final RI report. Most of report Sections 3.0 (Investigation Methodology) and 4.0 (Investigation Results) will be taken from the report on the Additional Landfill Investigation for the Landfill Operable Unit prepared in draft by BCM in March 1988. Section 4.0 will include results from the initial site investigation, additional landfill investigation, ~~and results of the proposed groundwater investigation~~ including a summary of these results, a description of the extent and state of contaminated soil and fill material, and a discussion of groundwater quality. ~~The groundwater investigation program will be initiated immediately upon approval by the EPA of this Work Plan.~~

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FIGURE 6-1

PROPOSED RI REPORT TABLE OF CONTENTS
HENDERSON ROAD LANDFILL OPERABLE UNIT SITE

EXECUTIVE SUMMARY

1.0 BACKGROUND INFORMATION

- 1.1 Facility Location and Use
- 1.2 Historical Description
- 1.3 Pre-Remedial Investigation Information
- 1.4 Nature and Extent of Problem – discuss Groundwater Prot. Strategy, classification of aquifer, implications for clean-up.
- 1.5 Remedial Investigation Methodology Summary

2.0 SITE AND AREA FEATURES

- 2.1 Physiography
- 2.2 Climate
- 2.3 Land Use and Demographics – include flood plain + watershed mapping + state classification of stream
- 2.4 Natural Resources

3.0 INVESTIGATION METHODOLOGY

- 3.1 Data Quality Objectives
- 3.2 Initial Site Investigation
  - 3.1.1 Surface Investigation
  - 3.1.2 ~~Landfill Investigation~~ Test Pit Sampling
  - 3.1.3 ~~Air Monitoring Investigation~~ Health + Safety Monitoring
- 3.3 Additional Landfill Investigation
  - 3.2.1 Underground Tank Investigation
  - 3.2.2 Test Boring Program
  - 3.2.3 Fate and Transport Evaluation
- 3.4 Groundwater Investigation
  - 3.3.1 ~~Monitoring Well Installation~~ Summary of Inv. Well O.U. well locations
  - 3.3.2 ~~Analytical Parameters and Procedures~~ Adequacy of existing gw data to characterize L.F.
- 3.5 Approach to RI to address data quality objectives
  - 3.5.1 LFOU characterization
  - 3.5.2 support end. assessment
  - 3.5.3 support development of FS Phases I + II
  - 3.5.4 Phase II RI

4.0 INVESTIGATION RESULTS

what is this? what followed results?

- 4.1 Subsurface Conditions
- 4.2 Analytical Results
  - 4.2.1 Initial Site Investigation (test pits ?)
  - 4.2.2 Additional Landfill Investigation
  - 4.2.3 Groundwater Investigation (eval. of relevant existing gw data. Discuss model confirmation in RD/RA.
- 4.3 Fate and Transport Evaluation
- 4.4 Air Monitoring Summary

X 76

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FIGURE 6-1 (Continued)

5.0 ENDANGERMENT ASSESSMENT

5.1 Hazard Identification

5.1.1 Compilation of Data
5.1.2 Identification of Chemicals of Concern – show entire screening process
5.1.3 Asbestos

5.2 Exposure Assessment

5.2.1 Exposure Pathways
5.2.2 Concentrations at the Point of Exposure

5.3 Toxicity Assessment
5.4 Risk Characterization

5.4.1 Estimation of Chemical Intakes
5.4.2 Risk Quantitation

5.5 Environmental Risk Assessment

5.5.1 Ecology of the Site
5.5.2 Exposure and Environmental Assessment

6.0 SUMMARY OF FINDINGS AND CONCLUSIONS

APPENDICIES

REFERENCES

6.1 Nature + Extent of Contamination
Fate + Transport
Risk Assessment
} Summary

6.2. Data limitations + Recs. for Future Work
Recommended Rem. Action Objectives
- include Aquifer Restoration
} Conclusion

11

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7.0 FEASIBILITY STUDY SCOPE OF WORK

7.1 INTRODUCTION

In October 1986, BCM Eastern (BCM) submitted to the U.S. Environmental Protection Agency (EPA) Region III, a draft Remedial Investigation (RI) Report for the Henderson Road NPL Site (Site) in King of Prussia, Pennsylvania. As a result of discussions between the Henderson Road PRP Committee, EPA, and BCM, two actions were taken by EPA:

1. Separation of the Site into two operable units (Injection Well Operable Unit and Landfill Operable Unit).

2. Request for additional investigation of the Landfill Operable Unit.

The draft additional landfill investigation report has been submitted to the EPA. That report discusses the results of the additional landfill investigation and provides a groundwater fate-and-transport analysis. A Remedial Investigation report will be prepared based on this work and the earlier investigation tasks and the endangerment assessment to be performed as outlined in Section 6.0. The FS will generally be conducted in accordance with the ~~Draft~~ Guide for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (~~March~~ 1988) USEPA.

Interim Final — August — ance

7.2 ALTERNATIVE DEVELOPMENT

Discuss. Phasing of RI/FS — see Compliance Schedule

7.2.1 SITE CHARACTERIZATION

7.2.1.1 Site Description and Background

The Site description and background section will be summarized from the RI document. This section will provide enough information, in sufficient level of detail, so that the reader relatively unfamiliar with the Site can understand the Site. A description of physical conditions relating to topography, geology, hydrogeology, climate, location, land uses, and related factors will be included.

7.2.1.2 Site History

A history of the Site will be included. This discussion will have particular emphasis on activities at the landfill and includes underground tank storage information, previous surface drainage to onsite pond(s), and previous trenching operations, in addition to landfill activities, and the technical, legal and administrative actions that contributed to the Site being placed on the NPL.

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7.2.1.3 Nature and Extent of Contamination

The chemicals of concern and their pathways will be summarized. Two significant media (soil and air), as well as surface and groundwater, will be summarized. Detailed discussion of these issues will be included in the Remedial Investigation Report. The RI will evaluate whether fugitive dust emissions and contaminated soils are threats to the public health and environment. The conclusion of the RI will be summarized in regard to these two issues covering:

- Present conditions of waste and facilities
- Contaminant effects
- Endangerment assessment

7.2.2 Remedial Objectives

The general remedial objectives of the Henderson Road Landfill Operable Unit Feasibility Study (LFFS) are:

1. ~~Reduction or~~ elimination of substantial potential threats to public health and the environment at the points of exposure.
2. Restoration of the aquifer, onsite and at UHR.
2. Meet the provisions of CERCLA and the Superfund Amendments and Reauthorization Act of 1986 (SARA) to reduce significantly and permanently the toxicity, mobility, or volume of hazardous constituents to the maximum extent practicable.
3. Source control of contaminants to reduce or eliminate off-site contaminant migration.
4. Comply with Applicable or Relevant and Appropriate Requirements (ARARs).

The objective of reduction or elimination of substantial potential threats to public health and the environment has been established to ensure that:

- All ~~complete~~ existing and potential exposure pathways pose no significant public health risk
- Contaminants of concern pose no significant threat or potential threat to the environment

Discuss aquifer restoration

The source control objective has been established to prevent the migration of contaminants from the Site in concentrations which would cause significant risk to public health or the environment. Specific remedial objectives include:

- Landfill closure to ensure no further contamination of the Site occurs
- Containment of contaminants onsite and/or removal of contaminants from the Site
- Permanent reduction of the toxicity, mobility, or volume of the hazardous constituents

7.2.3 Identification of Applicable or Relevant and Appropriate Requirements

The ARARs identified will be classified by whether they are chemical-, action-, or location-specific. This type of classification system is useful since most landfill closure ARARs are action-specific, while other pathways (water, soil, and air) may be chemical-specific. No location-specific ARARs (i.e., National Register of Historic Places) appear to apply. However, a detailed review will be performed to confirm this.

Federal RCRA landfill closure regulations (40 CFR Part 264) will be considered for classification as an action-specific ARAR. Other regulations to be considered for ARARs shall include, but not be limited to, Pennsylvania Department of Environmental Resources (PADER) Municipal Waste Regulations (Chapters 271 to 285), PADER Hazardous Waste Regulations (Chapter 75), and PADER Residual Waste Regulations. Preliminary listings of possible federal and state ARARs are contained in Tables 7-1 and 7-2.

There may be a concern with the air exposure pathway since windblown fugitive dust from the landfill could possibly present a concern to downwind receptors. Therefore, other possible ARARs that may apply include the Ambient Air Quality Guidelines established under the Pennsylvania Air Operating Guidance for Air Toxic substances and other air quality standards. A thorough review of possible air quality ARARs will be performed after the results of the air impacts analysis are available.

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TABLE 7-1

PRELIMINARY LISTING OF POSSIBLE FEDERAL APPLICABLE
OR RELEVANT AND APPROPRIATE REQUIREMENTS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Requirement	Rationale
1. Hazardous Waste Requirements (RCRA Subtitle C, 40 CFR, Part 264)	Standards applicable to treating, storing, and disposing of hazardous waste. "Land ban" requirements included
2. Safe Drinking Water Act	
a. Maximum Contaminant Levels (MCLs)	Remedial actions may provide cleanup to the MCLs.
b. Maximum Contaminant Level Goals (MCLGs)	SARA Section 121(d)(2)(A)(ii)
c. Underground Injection Control Regulations (40 CFR, Parts 144, 145, 146, and 147)	May be applicable to onsite groundwater recirculation systems.
3. Toxic Substances Control Act (15 U.S.C. 2601). TSCA health data, chemical advisories, PCB spill cleanup policy.	May be applicable to cleanup.
4. Health Advisories, EPA Office of Drinking Water	RI activities may identify presence of chemical for which health advisories are listed.
5. Clean Water Act (PL92-500)	
a. State water quality standards (PA Code Title 25, Chapter 95)	Remedial actions may include discharge to surface waters.
b. Federal water quality criteria (FWQC)	Remedial actions may include groundwater remediation and discharge to surface waters.
c. NPDES permit	Remedial alternatives may include discharge to surface waters.

Table 7-1 (Continued)

Requirement	Rationale
6. Clean Air Act (42 USC 7401)	
a. National Ambient Air Quality Standards (NAAQS) for six criteria pollutants (40 CFR Part 50)	Remedial alternatives may include incineration.
b. Public health basis to list pollutants as hazardous under Section 112 of the Clean Air Act.	Remedial alternatives may include incineration.
7. OSHA Requirements (29 CFR, Parts 1910, 1926, and 1904)	Required for workers engaged in onsite remedial activities.
8. Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands)	Both floodplain and wetland resources may be affected by the site remedial alternatives.
9. DOT Rules for Hazardous Materials Transport (49 CFR, Parts 107, 171.1-171.500)	Remedial alternatives may include offsite treatment and disposal.
10. Endangered Species Act of 1978 (16 USC 1531)	Considered in the public health and environmental assessment.
11. Fish and Wildlife Coordination Act (16 USC 661)	Remedial alternatives may affect wetlands and protected habitats.
12. Fish & Wildlife Improvement Act of 1978 (16 USC 742)	Remedial alternatives may affect wetlands and protected habitats.
13. Fish & Wildlife Conservation Act of 1980 (16 USC 2901)	Remedial alternatives may affect wetlands and protected habitats.
14. Health Effects Assessments	May be considered in the public health risk assessment included in RI report.
15. EPA's Groundwater Protection Strategy	Remedial alternatives must consider EPA classification of groundwater conditions at the site.
16. General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR Part 403).	Considered for remedial alternatives involving pretreatment of groundwater prior to treatment at a POTW.

TABLE 7-2

PRELIMINARY LISTING OF POSSIBLE COMMONWEALTH OF PENNSYLVANIA PROPOSED APPLICABLE OR RELEVANT AND APPROPRIATE STATE REQUIREMENTS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

	Requirement	Rationale
1.	Pennsylvania Solid Waste Management Act	Standards for treating, storing and disposing of hazardous wastes.
2.	Pennsylvania Clean Streams Law	Remedial actions may include discharge to surface waters.
3.	Pennsylvana Solid Waste Disposal Regulations, PA Code Title 25, Chapter 75	Standards for treating, storing, and disposing of hazardous wastes.
4.	Pennsylvania Pollutant Discharge Elimination System (NPDES) Rules, PA Code Title 25, Chapter 92	Remedial actions may include discharge to surface waters.
5.	Pennsylvania Water Quality Standards, PA Code Title 25, Chapter 93	Remedial actions may include discharge to surface waters.
6.	Pennsylvania Wastewater Treatment Requirements, PA Code Title 25, Chapter 95	Remedial actions may include discharge to surface waters.
7.	Pennsylvania Industrial Waste Regulations, PA Code Title 25, Chapter 97	Remedial actions may include discharge to surface waters.
8.	Pennsylvania Special Water Pollution Regulations, PA Code Title 25, Chapter 101	Applicable for permitted solid waste disposal facilities.
9.	Pennsylvania Air Pollution Control Regulations, PA Code Title 25, Chapters 121 through 143	Incineration is considered a potential remedial action.
10.	Pennsylvania Stormwater Management Act of October 4, 1978, Act No. 167	Remedial actions may require stormwater management systems.
11.	Pennsylvania Erosion Control Regulations, PA Code Title 25, Chapter 102	Soil disturbances during proposed remedial actions may require erosion and sedimentation control measures.
12.	Pennsylvania Hazardous Substances Transportation Regulations PA Code Title 13 (Flammable Liquids and Flammable Solids) and Title 15 (Oxidizing Materials, Poisons, and Corrosive Liquids)	Applicable to wastes shipped offsite for analysis, treatment, or disposal.
13.	Rare and Endangered Species Regulations PA Code Title 58	Considered in the public health and environmental assessment.
14.	Pennsylvania Municipal Waste Regulations PA Code Title 25, Chapters 271 to 285.	

Source: Pennsylvania Environmental Research Foundation, Inc. 1980

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give complete citation

The identification and selection of ARARs will be based upon the EPA Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements. These ARARs will address all identified pathways and, where appropriate, will be in consonance with those ARARs accepted in the Injection Well Feasibility Study. For the landfill closure aspect of the project, a review of ARARs pertaining to both hazardous waste landfills and municipal solid waste landfills will be performed and a recommendation on applicability of these requirements provided.

7.2.4 Identification and Screening of Remedial Technologies – Phase I – Phase II

7.2.4.1 Identification of Remedial Technologies

Prior to actual identification of candidate remedial technologies, general response actions will be identified. Based on a review of data generated in the RI and Landfill Investigation, categories of remedial technologies (e.g., landfill capping, air pollution controls, etc.) will be identified for applicability.

7.2.4.2 Identify Remedial Technologies

A series of feasible technologies will be identified for each previously identified response action. BCM will use the EPA "Handbook for Remedial Action at Waste Disposal Sites" (latest edition) for general guidance when identifying remedial technologies. Many other documents on remedial technologies will also be drawn upon.

7.2.4.3 Screen Remedial Technologies – Tie to general + specific remedial objectives

Site data gathered during the RI and subsequent data generated during the Landfill Investigation will be reviewed to identify conditions that may limit or promote use of certain remedial technologies. Technologies whose use is clearly precluded by site characteristics will be eliminated from consideration. General response actions which may be applicable to the Landfill Operable Unit include those listed in Table 7-3.

Any particular waste characteristic that will preclude the use of a particular technology will also be identified. Those technologies clearly limited by these characteristics will be eliminated.

Technologies that are substantially more costly than and do not provide a margin of protection or reliability greater than other appropriate technologies will be eliminated.

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TABLE 7-3

PRELIMINARY SCREENING OF GENERAL RESPONSE ACTIONS AND TECHNOLOGIES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

General Response Action	Purpose	A	NA	MA	Remedial Technology	Remedial Data Requirements
No Action	Leave site as is			x	None	Monitoring of contaminants and downgradient impacts
Capping	Isolate contaminants from the environment and prevent them from leaving	x			Capping	Geologic characterization, volume of waste, waste characterization
Complete Removal	Remove all solid wastes, contaminated sediments, and groundwater for offsite treatment/disposal	x			Excavation	Volume, chemical characterization
Onsite Treatment	Treat waste materials on site by various material handling and chemical processes to reduce contaminant levels			x	Incineration, biological, chemical, physical treatment	Waste characterization, toxicity and biological degradation potential
Offsite Treatment	Treat waste materials offsite by various material handling and chemical processes to reduce contaminant levels			x	Same as onsite	Same as onsite
In-Situ Treatment	Reduce contaminant levels via non-disruptive processes that treat the wastes in place		x		Volatile Capture	Same as onsite
Storage	Establish temporary facilities on the site to store wastes or contaminated materials		x		Staging Facilities	Volume, chemical characterization

recycling? See pg 63

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Table 7-3 (Continued)

General Response Action	Remedial Purpose	A	NA	MA	Remedial Technology	Data Requirements
Onsite Disposal	Establish permanent waste repositories onsite	x			Landfill	Waste characteristics
Offsite Disposal	Dispose of materials removed from the site at offsite facilities	x			Same as onsite	Same as onsite
Gas Venting	Contral methane migration	x			Passive or active venting system	Volume and area of waste
Encapsulation	Prohibit generation of contaminated groundwater			x	Fixation	Physical and chemical waste characteristics.
Leachate Control	Prohibit generation of contaminated groundwater			x	Capping, subsurface drains	Same as capping
Groundwater Recovery and Treatment	Eliminate groundwater contamination		x		Recovery wells, treatment systems	Subsurface characterization
Long-Term Monitoring	Monitor remedial program effectiveness			x	Cap inspection monitoring wells	Evaluation of post-remediation conditions
Relocation of Receptors	Relocate nearby residents temporarily (or permanently) away from site		x		-	-
Institutional Controls	Restrict use of site or downgradient uses	x			-	-

A - Applicable
NA - Not Applicable
MA - May be Applicable

Source: BCM Engineers (BCM Project No. 00-5808-01)

Technologies that have a history of unreliability, poor performance, or have not been fully demonstrated will be eliminated. However, this screening criteria will not be used to eliminate technologies that are considered alternative or innovative. Such alternative or innovative technologies will be incorporated into remedial alternatives should they be determined to provide a unique potential to achieve a remedial goal and/or result in significant cost savings.

7.2.5 Development of Remedial Alternatives

Following screening and selection of viable technologies, remedial alternatives comprised of technologies and actions and combinations of technologies/actions from Section 2 will be developed. These alternatives will be screened based upon technical, environmental/public health, and cost criteria. Impacts and factors to be considered will include the long term effects that a particular landfill closure approach would have on site uses and the uses of adjacent properties. Remedial actions to remediate the landfill will be in accordance with the applicable RCRA or sanitary landfill regulations.

Alternatives will be developed, to the degree possible, that will eliminate the need for long term management (including monitoring) at the site, with reduction of toxicity and mobility of contaminants as their principal elements. In addition, containment options involving little or no treatment and a no-action alternative will also be developed.

7.2.6 ~~Interim Reports~~ Phase I + II draft FS

An interim draft report describing the process and results of the identification and screening of remedial technologies and the development of remedial alternatives will be prepared and submitted to the EPA for review and comments. The description provided in this report will include:

- All components of PH I+II FS - see Guidance
- Mechanisms for achieving desired cleanup levels
- Consideration of effective cleanup technologies
- Validity of assumptions used to develop and screen alternatives
- Conformance with requirements under SARA
- Recommendations for treatability tests

Any additional data requirements will be identified in this report. EPA comments will be incorporated into the draft containing the complete feasibility study report.

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7.3 DETAILED ANALYSIS OF ALTERNATIVES – Phase III

7.3.1 Basis of Detailed Analysis

Develop general performance criteria for ea. alternative

For each alternative screened, preliminary design information will be presented in the form of expected ranges in sizings necessary to meet ARARs. The detailed analysis of the screened alternatives will be analyzed according to three broad criteria:

1. Effectiveness
2. Implementability
3. Cost

For each of these three criteria, several subsidiary issues will be addressed on both a short term and long term basis:

EFFECTIVENESS

Protection - protection of the community, workers, and the environment during both construction and long-term operation will be evaluated.

Compliance with ARARs - each ARAR will be reviewed relative to each alternative on both a short-term and a long-term basis.

Reduction in Mobility, Toxicity, and Volume - the permanence and significance of the reductions to mobility, toxicity, and volume will be evaluated.

Reliability - the potential need for replacement of the alternative and the resulting risk to workers, the community, and the environment.

Achievement of general + specific remedial objectives

IMPLEMENTABILITY

Technical Feasibility - The alternative should consist of technology(-ies) that are not considered experimental and have been shown effective in situations similar to that found at the Site.

Administrative Feasibility - Compliance with all applicable Federal, State, and local regulations, laws, and ordinances will be reviewed, particularly those that are not defined as ARARs. Possible community acceptance issues will be discussed.

Availability of Screened Technologies - A review of the necessary equipment, material, and expertise to implement each alternative will be performed.

COST

Capital - Construction cost estimates will be developed to within a minus 30 percent/plus 50 percent accuracy.

Operation and Maintenance - O&M cost estimates will be developed to within a minus 30 percent/plus 50 percent accuracy.

Replacement - any replacement costs for the particular alternative will be noted and their impact on the long-term cost addressed.

Present Worth - present worth costs based on 10-percent interest and 30-year planning period will be presented.

7.3.2 Selected Remedial Action

Based on the detailed analysis, a recommended remedial alternative will be presented. The selected remedial action will:

- Be protective of human health and environment
- Attain all Federal and State public health and environmental requirements including all identified ARARs.
- Be cost-effective in the sense that the results of a selected alternative cannot be achieved by less costly methods.
- Utilize permanent solutions and alternative technologies or resource recovery technologies to maximum extent practicable.

A general discussion of what further studies, if any, are required to confirm this recommendation will also be discussed.

The selected remedial action will represent the best balance across the effectiveness, implementability, and cost factors examined in the detailed analysis.

BCM

7.4 REPORT – Phases 1, 2+3

The work will be presented in the form of a draft report. The proposed table of contents for the FS report is presented as Figure 7-1. Twelve (12) copies of the revised draft report will be distributed to those entities EPA directs. EPA will coordinate and consolidate all comments received by EPA. Three weeks after receipt of comments, BCM will submit the final draft report for public review.

7.5 FURTHER WORK

Further work may be needed in Remedial Design to adequately design and size the selected remedial action. This further work could include, but may not be limited to:

- Further analytical work e.g. stream sampling, well development
- Geotechnical exploration
- Development of topographic survey
- Pilot and/or bench scale studies, if not conducted as Phase II RI

This section of the LFFS will identify what further work is necessary (if any) for Design and the general scope of this work.

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FIGURE 7-1

PROPOSED FS REPORT TABLE OF CONTENTS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 Purpose and Organization of Report
1.2 Background Information — 1.2. Phasing of RI/FS

1.2.1 Site Description
1.2.2 Site History
1.2.3 Nature and Extent of Contamination
1.2.4 Contaminant Fate and Transport
1.2.5 Baseline Risk Assessment

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Introduction
2.2 Remedial Action Objectives — clean-up criteria
2.2.1 General + Specific Objectives, ARARs identified on pre[illegible] basis
2.2.1 Contaminants of Interest
2.2.2 Allowable Exposure Based on Risk Assessment
2.2.3 Allowable Exposure Based on ARARS
~~2.2.4 Development of Remedial Actions Objectives~~

2.3 General Response Actions

2.4 Identification and Screening of Technology Types and Process Options

2.4.1 Identification and Screening of Technologies
2.4.2 Evaluation of Technologies and Selection of Representative Technologies

FIGURE 7-1 (Continued)

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

3.1 Development of Alternatives
3.2 Screening of Alternatives

3.2.1 Introduction
3.2.2 Alternative 1

3.2.2.1 Description
3.2.2.2 Evaluation

Effectiveness
Implementability
Cost

3.2.3 Alternative 2

3.2.3.1 Description
3.2.3.2 Evaluation

Effectiveness
Implementability
Cost

3.2.4 Alternative 3

3.2.4.1 Description
3.2.4.2 Evaluation

Effectiveness
Implementability
Cost

3.2.5 Summary of Screening

4.0 DETAILED ANALYSIS OF ALTERNATIVES - Phase 3 FS

4.1 Introduction
4.2 Alternative Analysis

FIGURE 7-1 (Continued)

4.2.1 Alternative 1

4.2.1.1 Description
4.2.1.2 Assessment

Short-Term Effectiveness
Long-Term Effectiveness and Permanence
Reduction of Mobility, Toxicity, and Volume
Implementability
Cost
Compliance with ARARs ; performance criteria for each alternative
Overall Protection
State Acceptance
Community Acceptance

4.2.2 Alternative 2

4.2.2.1 Description
4.2.2.2 Assessment

4.2.3 Alternative 3

4.2.3.1 Description
4.2.3.2 Assessment

4.2.4 Summary of Alternatives Analysis

4.3 Comparison Among Alternatives

4.3.1 Short-Term Effectiveness
4.3.2 Long-Term Effectiveness and Permanence
4.3.3 Reduction of Mobility, Toxicity, and Volume
4.3.4 Implementability
4.3.5 Cost
4.3.6 Compliance with ARARs (clean-up criteria + performance criteria)
4.3.7 Overall Protection
4.3.8 State Acceptance
4.3.9 Community Acceptance
4.3.10 Summary of Comparisons Among Alternatives

4.4 Summary of Detailed Analysis

REFERENCES

APPENDICES

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8.0 SCHEDULE

Task	Period
~~A. Initiate Endangerment Assessment~~	~~Within 1 week of EPA's authorization of Work Plan~~
~~B. Complete Endangerment Assessment~~	~~Six weeks after A~~
C. Submit draft RI to EPA	Four weeks after receipt of these comments
D. Submit Final Draft RI to EPA	Two ~~Four~~ weeks after receipt of comments on draft RI or submission of treatability tests results
~~E. Initiate FS~~	~~Within 1 week of EPA's authorization~~
~~F. Submit Draft of Sections 1.0 and 2.0, including ARARs, to EPA~~	Submit draft FS, Ph 1+2 to EPA with recs. (see item M in compliance schedule) ~~Eight weeks after D~~ Four wks after receipt of their comments
G. Submit Draft FS, phase 1,2+3 and including performance criteria	~~Six~~ 4 weeks after ~~receipt of comments on F~~ final RI submitted
H. Submit Final Draft FS	3 ~~Four~~ weeks after receipt of comments on G
Public Comment - 30 days	
I. Submit Final RI and FS	Four weeks after receipt of comments on H

BCM

REFERENCES

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Enclosure 3

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September 30, 1988

Ms. Gerallyn Downes-Valls
U.S.EPA Region III
PA CERCLA-Remedial Enforcement Support
841 Chestnut Street
Philadelphia, PA 19107

EPA Contract No: 68-01-7331
Document Control No: T99-C03-LR-CMZL-1

Subject: Letter Report of Comments to Draft Remedial Investigation/Feasibility Study Work Plan for the Henderson Road Landfill Operable Unit, September 1988

Dear Ms. Downes-Valls:

CDM Inc. is pleased to submit comments to the Draft Remedial Investigation/Feasibility Study Work Plan for the Henderson Road Landfill Operable Unit, September 1988, prepared by BCM Eastern Inc. General comments are presented below, followed by specific comments which are presented in attachment A.

General Comments

The work plan has incorporated or addressed many of the concerns presented in the August 5, 1988, EPA comments to BCM. The following should be addressed in the RI/FS.

- Contaminant distribution should be well defined in order to consider and evaluate alternatives involving partial excavation and treatment/disposal of soils and waste material. A discussion of the approach that will be taken in the feasibility study to address excavation and treatment alternatives should be included. For example, does BCM consider that the entire fill area will require remediation?

- Specific criteria which are necessary to determine the extent of remediation required should be presented.

- A complete discussion of how risk will be assessed for the stream area will be needed.

- Specific remedial objectives should be presented as they apply to ground water, surface water and air.

- o An independent check of the fate-and-transport model should be performed after obtaining more data on the ground water aquifer.

- o The narrative describing the development of the alternatives in the FS does not reflect the March 1988 EPA Guidance Document. However, the FS outline (figure 7-1) does reflect the outline presented in this guidance document.

If your have any questions, please feel free to contact me.

Very truly yours,

CAMP DRESSER & McKEE INC.

Gracie Coffey for Debra Glover

Debra S. Glover

DG/lm

(50)

ATTACHMENT A

SPECIFIC COMMENTS

- Page 6, paragraph 3 (and throughout the text) - Many of the references are not presented in the reference section (i.e. Newport, 1971; and Berg and Dodge, 1981).

- Figure 3-1 - Please check the depth of the fill material at TP-12.

- Page 12, paragraph 3 - How were surface water and sediment samples used to establish air quality characterization prior to the initiation of field activities.

- Page 12, paragraph 3 - The reference to figure 2-1 should be 3-1.

- Page 12, last paragraph - It appears that all of the "SED" samples were analyzed for the same parameters; please combine the two sentences.

- Page 13, paragraph 2 - The units for the concentration of trichloroethene in B52 should be µg/kg

- Page 13, paragraph 3 - Place a comma after "(5,500 µg/kg)"

- Page 13, paragraph 4 - The version of "milligram per kilogram" should be placed before the first use of the abbreviated version.

- Page 13, last paragraph - Change "1,1,1-trichloroethene" to "1,1,1-trichloroethane".

- Page 19, last paragraph - What was the criteria for selecting sample for analysis.

- Page 23, paragraph 2 - The concentration of arsenic and copper should be 2.01 and 100 mg/kg, respectively.

- Page 23, paragraph 3 - The reference to the test pit sample here (TP-12) is inconsistent with the sample presented in table 3-4. Should the sample be TP-2 or TP-12?

- Page 23, paragraph 3 - The concentration of copper should be 106 mg/kg.

- Page 24, paragraph 3 - Reference to sample "B" should be "B-4". The reference to figure 2-1 should be 3-1.

- Page 31, paragraph 2 - At what concentrations were the volatile organics detected in the trip blanks.

- Page 31, paragraph 3 - Only nine, not eleven, semi-volatile compounds are listed here.

- Page 32, paragraph 2 - Add arsenic to the list of inorganic parameters.

- Page 32, paragraph 2 - Close parenthesis after the magnesium concentration.

- Page 35, paragraph 1 - Reword the first line

- Page 40, paragraph 3 (line 3) - Insert "depths ranging from" before "approximately 3 to 18".

- Page 40, last paragraph - The "study chemicals" and their selection process should not be confused with chemicals of concern (and the associated selection process) in the Endangerment Assessment.

- Page 42, first paragraph - Reverse the order of "surface" and "site".

- Table 4-2 - Delete "average" from the title.

- Table 4-3 - The parameter unit under the average solid concentration should be changed to µg/kg.

- Table 4-4 - Why were concentrations from TP-12 used instead of TP-14 (TP-14 had much higher concentrations detected in the soil and leachate samples):

- Table 4-4 - Units (mg/kg) should be consistent throughout the text.

- Tabel 4-4 - There does not appear to be a reference to table 4-4.

- Page 48, paragraph 2 - Was effective porosity taken into accounted when calculating the velocity?

- Page 52, paragraph 3 - The fuel reference should be presented in the reference section.

- Page 52, paragraph 5 - "polyaromatic hydrocarbons" should be changed to "polynuclear aromatic hydrocarbons".

- Page 55 - What is the recommendation for comment number 3?

- Page 62, last paragraph - In order to appropriately dispose of waste materials offsite, a determination has to be made as to whether the material is a RCRA hazardous waste or not.

- Page 63 - What information will be used to evaluate the feasibility of recycling, incinerating, and landfilling the site related waste/fill material.

- Table 6-1 - Other analysis such as CLP inorganics should be considered.

- Page 68 - Analytical results from TP-14 should also be considered because concentrations here were comparably high.

- Page 68, last paragraph - The reference to section 6.1.7 is incorrect; no such section exists in this document.

- Page 70, paragraph 3 - Separate the word "chemicalsfor" to read "chemicals for"

- Page 71, paragraph 3 - Again, there is no section 6.1.7 in this document.

- Page 72 - Will dermal contact with contaminants in the standing water on the landfill be considered?

- Page 73 - A section on the comparison of contaminant concentrations to State and Federal Environmental Standards, Guidelines, and Criteria is missing.

- Page 73 - The ISC is fine for predicting concentrations of pollutants in a non complex terrain and if inhalation is the exposure pathway. If, however, other pathways (i.e, ingestion) are being evaluated, a few models to predict pollutant deposition, such as, CARB or hand estimates using settling velocities may be more appropriate.

- Page 74, Area Residents - Exposure to children should also be evaluated because access to the property is not secure.

- Page 75 - Concentrations of environmental chemicals should be compared to Federal Ambient Water Quality Criteria or other values where appropriate.

- Page 75, paragraph 3 - What is the source of the toxicity values (NOEL, LC_{50} etc.)?

- Page 79 - Include aquifer restoration as a remedial objective

- Page 85 - The date of document release should be presented with the EPA references.

- Table 7-3 - General response actions which should also be considered (although they may not be developed into alternatives) are:

a) Containment such as slurry walls
b) Partial removal of soils (hot spots)
c) Ground water recovery, treatment and monitoring

o Table 7-3 - Technologies which should also be considered are:

a) Insitu treatment by: biodegradation
chemical treatment
physical treatment
b) Encapsulation by: Solidification (which is not the same as fixation).
c) Storage appears to be applicable at the site as part of a temporary remedial action (such as storage before disposal.)

o Page 88, section 7.2.5, first paragraph, last sentence - Landfill remedial actions should be in accordance with CERCLA and RCRA requirements

o Page 89, Section 7.3, Detailed Analysis of Alternatives - The FS guidance calls for the following:

1. Development of Alternatives (from available technologies).

2. Screening of Alternatives on the basis of
   - Effectiveness
   - Implementability
   - Cost

3. Further development of Alternatives (may require treatability studies etc.).

4. Detailed Analysis of Alternatives (using nine criteria as presented in the FS guidance document)

   - short term effectiveness
   - long term effectiveness
   - reduction in toxicity, mobility and volume
   - implementability
   - cost
   - compliance with ARARs
   - overall protection of environment
   - state acceptance
   - community acceptance

5. Summary of Detailed Analysis of Alternatives (see section 7.0 of FS guidance for more detail on this part of the work)

o Page 90 - A five percent interest rate is recommended in the March 1988 Guidance Document.

o Figure 7-1 - This figure reflects the current guidance however, the text does not. The text should be revised accordingly.

- Appendix D – Calculations provided in this appendix for mass of soil in landfill, and therefore travel time should account for porosity. The Equation for computing mass of soil in the Landfill (W_S) should be:

  $W_S = GV\ \rho\omega\ (1-\phi)$

  G = Specific gravity of soil
  V = volume of soil
  $\rho\omega$ = Density of water
  ϕ = Porosity

  If this equation were used, the travel time should be reduced by approximately 70%.

(51)